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INDIA'S WILDLIFE IN 1959-70

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INDIA'S WILDLIFE IN 1959-70

An ecological Survey of the larger Mammals of Peninsular India

M. KRISHNAN

WITH 242 PHOTOGRAPHS

BOMBAY NATURAL HISTORY SOCIETY

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INTRODUCTION

This report is based on many years of observation in a great many faunal areas widely distributed over peninsular India. Some of the work was planned, sustained and intensive, the rest of it sporadic and done as opportunity offered. The report is documented by 242 photographs selected from several thousands taken over 12 years, from 1959 to October 1970, and is largely supported by the field notes written up each day during this period and by personal experience.

This general statement needs amplification both to indicate adequately the factual records of the report and to expose their limitations. While a considerable body of record (observation notes and photographs) prior to 1959 is available, it was decided to make that year the starting point of this survey, because it was only from then on that photography was regularly employed as part of the field work to supplement and complement observation. The value of photographic documentation (briefly set out in the section on photography, later here) was realised much earlier, but it took years to build the cameras I needed for the work and to develop an adequately versatile photographic technique, largely owing to personal limitations.

All field trips prior to 1959 have been left out of the records of this survey. Many field trips made during the first 10 years of the 12-year period have also been left out because they were to faunal areas outside the region of peninsular India (though a few relevant extracts from trips to the Jaldapara sanctuary of West Bengal, the Kaziranga and Manas sanctuaries of Assam, and the Corbett National Park and the Dudwa preserve of Uttar Pradesh have been included), or because they were mainly floristic or photographic trips, or else because it was not possible to revisit those areas for a check on earlier observation during the last 2 years when intensive work was done on the Jawaharlal Nehru Fellowship. The field notes appended[1] provide full details of the areas visited, the duration of each visit, and seasonal and other particulars. Brief accounts of the terrain and main floristic features of the Periyar, Mudumalai, Point Calimere, Bandipur, Kawal, Hazaribagh and Palamau sanctuaries have been provided later in this report. As far as possible,

[1] The field notes are omitted in this publication for reasons of space. However, these notes are available in typescript with the Bombay Natural History Society, and are being held by the Society.

during the last 2 years, two visits were made at the same time of the year to areas already visited earlier and to new faunal areas. The study locations, in 8 States, are listed below (full details will be found in the field notes and photographs): *Kerala*: the Periyar Sanctuary (and one isolated record from Quilon); *Tamil Nadu*: the Mudumalai Sanctuary (which was intensively worked, over years) and the Point Calimere Sanctuary (and selected records from Guindy Park in Madras, Topslip in the Anamalais, and Sholinghur); *Mysore*: the Bandipur Sanctuary (and one isolated record from the Ranganathittoo Sanctuary); *Andhra Pradesh*: the Kawal Sanctuary (and passing references to the Pakhal and Eturnagaram Sanctuaries); *Orissa*: Balimela, Chilka and surroundings, Tickerpara and surroundings, the Usha Kothi Sanctuary in Badrama and the Raigoda Sanctuary, and the Simlipal hills; *Bihar*: the Hazaribagh and Palamau National Parks, with brief visits to the Baresand area, Tholkobad and Karkatnagar; *Madhya Pradesh*: the Kanha National Park, with brief visits to Churna (Bori), the Shivpuri National Park, Bastar and Bara Naya Para; *Maharashtra*: the Taroba National Park.

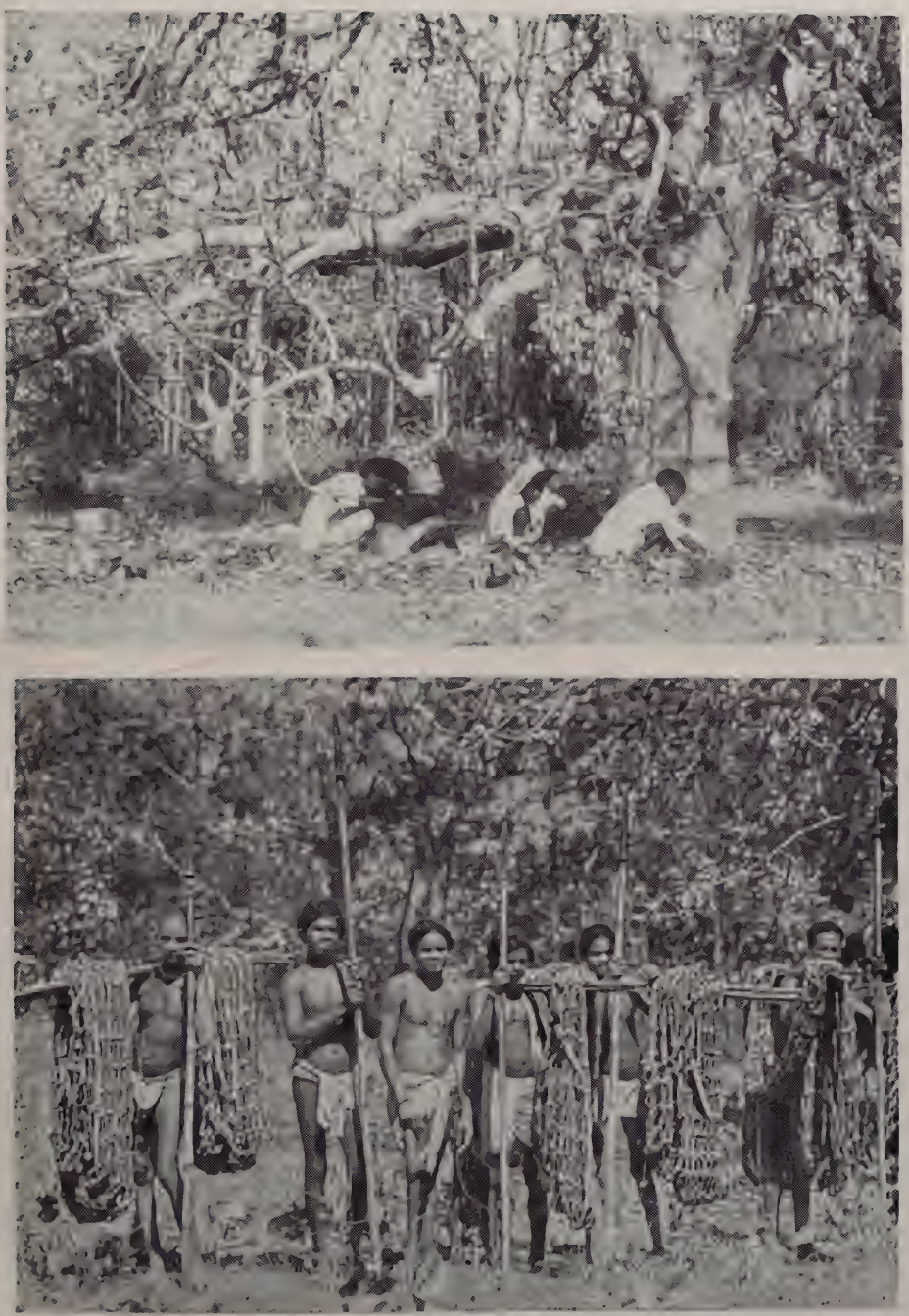
Some important areas with a distinctive fauna, like Gujarat and Rajasthan, were not visited at all. It was not possible to do so because, during the last 2 years when intensive work could be done, it was decided to do it in areas already known and contiguous tracts so as to obtain reliable records from a series of sample surveys, rather than to break new ground.

Acknowledgements

The grant of a Fellowship for an ecological mammalian survey of peninsular India, by the Jawaharlal Nehru Memorial Fund, enabled me to bring my work until October 1968 to some shape by sustained and continuous field work and photography over the next 2 years, and to complete this report. It was a real privilege to be trusted so entirely to plan and execute an ambitious project. My thanks are also due to the Bombay Natural History Society for suggesting that I might be entrusted with this survey. I can only hope that this report is, in some measure, worthy of the trust reposed in me by the Jawaharlal Nehru Memorial Fund and the Bombay Natural History Society.

It is with pleasure and thankfulness that I acknowledge the generosity of the Governments and Forest Departments of Kerala, Tamil Nadu, Mysore, Andhra Pradesh, Orissa, Bihar, Madhya Pradesh and Maharashtra in providing me with all facilities for work in their forests. Members of the Forest Departments of these States, at all levels, have helped with local guidance and advice, and in other ways, and I am grateful to them for help received.

To my brother professional photographers in Madras and other friends who have responded so unfailingly to my usually exacting and invariably



Above : BIHAR 1968 : HAZARIBAGH N. P. : April 16 — dawn : Men picking fallen flowers from under a mohwa tree — B.1 ; *Below :* M. P. 1970 : BASTAR : March 27 : About 9 a. m. at Mukhaveli : Muria hunters, with nets and spears — MP. 40.

(*Photos : M. Krishnan*)

Above: TAMIL NADU 1969 : PT. CALIMERE : December 18 — p.m. : Feral ponies — TN. 58 ; *Below:* BIHAR 1970 : BETLA : PALAMAU N. P. : February 22 — 1 p.m. : Rhesus at Madhuchuan — B. 32.

(*Photos : M. Krishnan*)

urgent calls upon their time and skills over the past 12 years, I owe such a polymorphic debt that I can only record my thankfulness to them all here generally. However, I am specially indebted to K. Krishnamoorthy, Conservator of Forests, Kerala (now retired) and to Dr. B. G. L. Swamy, Chief Professor of Botany, the Presidency College, Madras, for identifying plants for me and for discussions of forest ecology in India; to B. V. Seshaiah, ace-photographer, for discussions of ways and means for extending the frontiers of photography to suit my field work; to V. H. Sivamani Nadhan and K. Mani for technical help and advice in the devising of my photographic equipment; and to C. Gowrishankar and K. Krishna Murari Rao for aid in many ways. I also acknowledge help received from my son, M. Harikrishnan of the Indian Forest Service, with floral identifications, floristics and stray faunal observations, and am indebted to my wife, Indumati Krishnan, for much help with the typescripts.

The Photographic Record

The main value of a clear photograph in supplementing and complementing visual observation in the field is that the camera's vision is comprehensive and unbiased. Many particulars that the eye might miss for various reasons, such as the confusion resulting from the movement of a number of animals in bush cover, or by the eye being preoccupied with some displayed feature or action of the subject to the exclusion of less flagrant details, are recorded unselectively by the camera, so that study of a clear enlargement of the photograph often reveals details that the observer might have missed. This truth is widely recognised in the copying of documents by photography to ensure total fidelity, but insufficiently appreciated in faunal field work. However, for worthwhile photographic records of wild animals it is necessary that the subject should be truly wild and free—or, to put it in photographic parlance, that the record should be candid. It is conceded generally by students of animal behaviour that the responses and behaviour of wild animals in captivity and in contrived situations are often misleading.

Two practical photographic difficulties arise from this. Obviously, the photographer-cum-observer has his best opportunity when his presence is undisclosed to his subject, as when he is in a hide. Early experiments with ground-hides and more portable camouflage soon exposed their limitations. Apart from the lack of mobility which they inevitably involve, they have major set-backs when employed for the observation of mammals in Indian forests, excellent as they are for bird photography. Most forest mammals depend even more upon smell than on sight, and frequently the photographer inside a ground-hide is discovered by his subject even before he is aware of its proximity, and

thereafter never gets even a glimpse of it. Worse still, in elephant country such hides can prove quite dangerous, as I can attest from personal experience. Tree-seats and machans, sited high enough for the human occupant's smell to pass above the animal's questing nose, are much more useful, especially as they can give the watcher a good, overall view, but they are easily detected visually. However, some work was done from such elevated stances.

With free-ranging animals like gaur, deer and predators, it is often possible, when the initial approach has been displayed and casual from a sufficient distance, and has caused no alarm, to get them to accept human beings in a motor vehicle or on elephant back, and it is thereafter possible to edge gradually in for photographs from close up. In this, for some reason, the much quieter sneeze of the Compur shutter seems less acceptable to most animals than the thud of the focal-plane shutter, but undoubtedly a loud thud upsets them, and has to be muffled. It is my experience that animals are much more sensitive to being photographed with an eye-level camera than with a camera held at chest level, where the ground-glass screen can be viewed without looking directly at the animal. Gaur, deer and most predators will not accept men on foot, and though there is a photograph of a gaur and a sambar in the photographic record of this survey, taken on foot, both were photographed not by getting them to accept me but by stealth. Most of the photographs documenting this report were taken from elephant back, a motor vehicle or boat, or a tree-seat. Elephants and monkeys are best photographed on foot, though much care is needed in approaching the former in most parts of India. Almost all the elephant and monkey pictures were taken on foot.

The second and less obvious difficulty in wildlife photography in the forests of India is that even where the photographer is mobile, he cannot usually choose his stance or the subject's background, and has to take his pictures as he finds them, so that adequate tonal separation between subject and surroundings and clarity of record (an essential) has to be achieved entirely by photographic technical shifts and not by posing the subject, or by waiting for it to reveal itself in a literally more favourable light—such forbearance usually results in his losing it altogether! This consideration is of much greater consequence than may be imagined, for in our forests the lighting is often extremely contrasting, with hardly any reflectance from the highlights into the shadows. For this reason, a thorough understanding of the colour rendering of the emulsion in use as also of the exploitation of the relationship between exposure and development is necessary for good candid pictures.

Considering how integral a part of this report its photographic record is, two further matters may be briefly set out. An original attempt was made to evaluate the comparative size of the same species (average specimens) in different areas, purely by photography. This failed because

of accidental damage to the camera specially constructed for this purpose, but is sufficiently interesting to be retailed here.

In this camera, the rigid parallelism of the lens board to the film plane was ensured by the lens board moving along two tracks set at right angles to each other. The camera was equipped with a 240 mm. telephoto lens of hard definition, with a maximum aperture of f 5.6, and the traverse of this lens from infinity to 15 feet was accurately calibrated. Further, a rigid lock was provided so that the lens could be locked at any desired position on the footage scale. The lens was locked when it was focussed at 100 feet, and a rangefinder right beneath the viewfinder was also locked set at 100 feet. Depth of field tables are calculated on contact prints, so that when the negative is enlarged to 10 or 15 diameters, the depth is very shallow even at 100 feet for a lens of the focal length used at its maximum aperture of f 5.6, only about 8 feet. Preliminary experimental work showed that it was not too difficult to move back or forward a few feet, when one was about 100 feet from chital, gaur and other animals, so as to get the split images in the rangefinder to coincide exactly, though at this distance it was not possible to eliminate errors of a few feet. I hoped to use this camera, set up on a tripod if possible a measured distance of 100 feet from some animal path used by chital and other animals, and to photograph them (by remote control, if necessary, the camera being equipped with a solenoid which could be operated from 100 feet away) at 100 feet, broadside-on, in different areas. Errors in the estimation or measurement of the distance would be immediately shown up when the negative was scrutinised through a highpower magnifier, and it was proposed to mark all successful negatives with code numbers, to indicate the date and area of each picture, and then to evaluate comparative size in different areas by measuring the 15-diameter blow-ups from the successful negatives. Image size, in such a set-up, being directly proportional to subject size and nothing else, it should have been possible to get reliable comparative data by this method. The main difficulty, in fact, would have been not in the photography so much as in the ensuring that the subject and camera were on a plane more or less (otherwise foreshortening and other perspective errors might have complicated matters). Owing to the footage-scale of this camera getting damaged beyond repair in a road accident, soon after it was built, it was not possible to lock the lens at 100 feet and hence the attempt was abandoned. However, since the traverse of the lens was unaffected up to 75 feet (the maximum distance at which pictures could be taken at night with the aid of 2 Metz 502 electronic flashes) it was used exclusively for night photography, and all the night pictures in the record were taken with it.

In many faunal areas (for example in Andhra Pradesh, Orissa and parts of Bihar) animals which are diurnal in less disturbed habitats have turned crepuscular and nocturnal: in fact, in these locations, only

at night could any wild mammals be seen, and it was important to my survey that I should get clear pictures of them. The problem here was twofold. The spill of light from the wideangled flash-heads on to the bonnet and other parts of the jeep resulted frequently in reflection-flares that completely ruined the pictures : hoods to narrow the throw of light were devised for the flash-heads, and this also helped in the more even illumination of the field from about 30 feet away. The second problem was that driving along forest roads in an open jeep at night, it was seldom possible to see animals closer than 50 feet away, and inadvisable to open the aperture wider than f 8, as some depth of field was highly desirable—at night the rangefinder could not be used and setting the lens by guessing the distance, the lens had to be stopped down slightly to allow for small errors in the estimation of distances. The guide-number used by professional photographers for taking pictures of open-air processions at night were far too high in the jungle, even though they used the same film and the same electronic flash as I did. Using 2 synchronised flashes, and forced development, I found that printable negatives could be obtained when the subject was 50 feet away, with the lens aperture at f 8, but *not* at 60 feet. Finally and somewhat desperately a new technique of forced development was evolved which solved the problem. The film (Kodak Tri-X Pan) was developed in May & Baker Promicrol at a dilution of 1 : 2½ and development continued till a slight base-fog built up. The time taken for such unobjectionable fogging was noted, and 4 times the tank capacity of the diluted developer was mixed. Then, fixing the time at a little less than the time fixed originally, the used developer was poured out and replaced by fresh developer thrice, at quarter the development time fixed. Successful negatives were obtained even with the subject 75 feet away by this technique.

Scope, Bases and Arrangement of the Report

Being mainly based on a series of repeated sample surveys, in many of the best faunal areas in peninsular India, carried out over a 12-year period, this report has no pretensions to being a study of distribution or a taxonomical natural history of the mammals of the region: it is, in fact, a factually-based ecological mammalian evaluation dependent mainly on the study records specified already, and also on earlier experience and knowledge. All individual faunal assessments, as distinct from the reports of a team of workers, are substantially of this nature, but usually they contain the sum total of the faunal knowledge of the author up to the period of publication. In this report, however, the field records have been limited to a period of 12 years from 1959 for reasons already stated, and even within this period, the observation made during brief trips, unsupported by detailed, on-the-spot field notes, has been left out.

Above: TAMIL NADU 1970: MUDUMALAI SA.: Theppakkadu: September 21 — p.m.: Bonnet monkey grooming young — TN. 60; *Below:* MISCELLANEOUS: Sholinghur, TAMIL NADU: 1960: May 24 — p.m.: Bonnet monkey mother swimming with her young on her back — MISC. 1.

(*Photos: M. Krishnan*)

TAMIL NADU 1966 : MUDUMALAI SA. : September 27 : Bonnet Monkeys — TN. 47A.

(*Photo : M. Krishnan*)

For instance, it will be noticed that the records relating to one of the commonest wild mammals of the region, the bonnet monkey, are quite meagre. I have watched and photographed this monkey in many places where it is the local faunal feature, such as Tirupathi, Courtallam, Papavinasam, Siddharkoil, Jalarpet, Kodaikanal Road, and in and around some suburban towns, but these observations have not been included in the field notes here for chronological reasons, or because there are no detailed notes supporting them, or because they were not made in forest areas. Similarly, no mention at all is made of the commonest diurnal wild mammal of peninsular India, the palm squirrel, for though many photographs and even observation notes of it are available, they are wholly unrelated to the forest areas in which the work on the survey was done.

The field notes[1] have been analysed and the sight-records (varying in duration from a mere glimpse to 3 hours of close watching, and in number from an individual to a herd) of each species mentioned in them separately collected and studied. Since this report is ecological and not on behaviour, the approximate total duration of all observation has not been specified for each species, but other details culled from these field notes have been briefly specified at the commencement of the chapter on each species. In these chapters, as well as in the chapter which provides the overall survey, references are made to photographs and field observations supporting statements and conclusions. For this purpose, the study locations have been prefixed with initials, following their arrangement in the field notes and photographs, as indicated below :

Kerala	K
Tamil Nadu	TN
Mysore	MY
Andhra Pradesh	AP
Orissa	O
Bihar	B
Madhya Pradesh	MP
Maharashtra	MR
Other miscellaneous areas	MISC

These initials, followed by the year, month and date of the observation, should be quite adequate for the immediate location of the passage in the field notes to which reference is made. Similarly, the code number of any photograph will suffice to locate it, by reference to the list of photographs provided.

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[1] See footnote at p. 1.

Evidentiary Records outside the Report

Thousands of negatives from the field trips made during the 12-year period of this survey (roughly, 6000 negatives) have not been printed for this report for various reasons, though they were all scrutinised and many have been printed in the past for other purposes. The main reason for this, of course, was that some reasonable limit had to be set to the number of illustrations to any text. Many of these negatives are repetitive, being pictures of the same subject taken in sequence at one opportunity; many are of poor quality and are only proof of the subject having been seen in the circumstances set out; a great many have only pictorial and not evidentiary value. Nevertheless, these negatives have been sorted out and stored, so that in the unlikely event of any statement made in this report requiring additional proof, they may be available in case they contain the evidence needed.

During the first 10 years, some of the observation notes and photographs from field trips were used in faunal contributions to newspapers and magazines, and also in survey reports to governments, mainly for my 'Country Notebook' column in *The Statesman*. It is therefore possible to establish that these observation notes were anterior in point of time to those publications and reports.

Nonprovision of Bibliography

The nonprovision of a bibliographic list of the faunal literature consulted or relied upon (as an appendix to this report) may be explained here. I am indebted to booklore for much of my knowledge of Indian wild animals, to some 50 books. These are of 3 main categories, shikar literature, the accounts of naturalists and conservationists, and faunas and specialist studies, compilations and reports.

Among the authors of shikar books I have read, the following may be mentioned, more or less in chronological order: W. Rice, M. H. Shakespear, J. Forsyth, J. Baldwin, E. Braddon, J. Inglis, A. J. O. Pollock, D. Hamilton, G. P. Sanderson, E. F. Burton, R. Sterndale, C. E. M. Russell, A. Mervyn Smith, A. I. R. Glasfurd, the Maharajah of Cooch Behar, S. Eardley Wilmot, E. P. Stebbing and F. W. F. Fletcher (*c.* 1860 to 1912): Best, A. A. Dunbar Brander (his is really much more a valuable natural history than a shikar book), R. G. Burton, Hewett, C. H. Stockley, Musselwhite and Wardrop, between the two World Wars: and thereafter, J. Corbett, K. Anderson, A. Locke, A. Powell, Kesri Singh and H. Allen, most of them writing about tiger hunting.

Among the books of conservationists and naturalists should be mentioned TWO YEARS IN THE JUNGLE by W. T. Hornaday (who came to

India in 1877), WITH A CAMERA IN TIGER-LAND and THE JUNGLE IN SUNLIGHT AND SHADOW by F. W. Champion (notable for their magnificent photographs), THE WILD LIFE OF INDIA by E. P. Gee (a sound over-all account with many fine photographs), ELEPHANT GOLD and TIGERS by P. D. Stracey, and THE TWILIGHT OF INDIA'S WILDLIFE by B. Seshadri.

The faunas and specialist studies and publications include MAMMALS OF INDIA by Jerdon, the 2 volumes on mammals in THE FAUNA OF BRITISH INDIA by W. T. Blanford, Sterndale's MAMMALIA OF INDIA revised by F. Finn, THE BOOK OF INDIAN ANIMALS by S. H. Prater (second edition, 1965), THE DEER AND THE TIGER by G. B. Schaller, and notes and articles in the *Journal of the Bombay Natural History Society* (the last two specially valuable). Naturally, other scientific faunal books not dealing specifically with Indian mammals were also read, but are not indicated here.

If this report was primarily concerned, as it is not, with the decline of the country's mammalian wildlife over the past 100 years, an accurate bibliography of all these and some other books would have to be provided. For example, in the Banjar Valley area of Madhya Pradesh, the faunal decline is graphically indicated by what Forsyth, Dunbar Brander and Schaller have written of the local fauna as they knew it in 1861-63, 1900-21, and 1963-65 respectively: Brander further records the decline within the 20-year period of his knowledge of the area. Where such comparative assessments by different observers, spread over different periods of a century, sustain the argument of the text of a report or analysis, the dates and other details of publication of the sources have value and should be furnished in an appendix. In the present report, limited in period and confined largely to a series of repeated visits to widely scattered faunal areas, an added bibliography would serve no useful purpose and can only be pretentious. Further, to be properly done it would entail an enormous amount of work and time—in no book on India's fauna published in the last 3 decades that I have seen is the bibliography complete or wholly free from error.

Wherever it is necessary to refer to the opinion or record of any authority either to corroborate some statement in this report, or because my observation or inference differs from that of others, specific citation of such agreement or difference will be made in the text.

Population Figures: Quantitative Faunal Assessments

In the areas worked, the populations of some free-ranging species, such as elephants and gaur, naturally displayed considerable fluctuations with the seasons; further, even at the same time of the year, there were noticeable fluctuations in their numbers in different years caused, apparently, by climatic or other seasonal variations like drought or

unseasonal rainfall. Other species, like chital and muntjac, were widely distributed over many localities either in mobile populations (chital) or individually (muntjac), so that working singlehanded and for a limited period in each area, it was not possible to attempt even a rough count in all localities. Again, the predators were either so largely nocturnal, like tigers and leopards in most places, or so little given to residence in particular localities, like wild dogs, that it was exceedingly difficult to see them, leave alone count their numbers. In many areas where the normally diurnal animals had become furtive creatures of the night owing to sustained disturbance by humanity during the day, drives along forest roads were regularly undertaken, usually both an early drive at nightfall and another late at night, and sometimes predawn drives as well.

In places the sanctuary authorities had conducted a regular census, and where this had been done, close inquiry was made into the methods employed, and the official figures studied. All that is expected of a faunal census is an approximation to the truth, and even where the approximation is wide, if it is adequately representative and if the method employed is sound, a census, enumeration or rough count is better than an educated guess. But where the method is unsound and some of those entrusted with the counts are inept, the census figures obtained, while possessing the verisimilitude of all statistical figures comprehensibly displayed, might be widely misleading. Only in a few instances did the official figures seem substantially true.

Everywhere, but especially in areas where the animals were hard to see, all means other than actual sight records were exploited to determine the presence of wild animals—by exploring nullahs, the edges of pools and water-holes, and forest paths, and noticing and studying footprints (usually with the aid of skilled trackers), forms, fæces, the regurgitated stones of fruits by cud-chewing animals, evidence of feeding offered by the vegetation, and by listening carefully for animal sounds, especially early in the morning and late in the evening. Local inquiry was also made of forest-side villagers and others, but with experience less and less reliance was placed on hearsay.

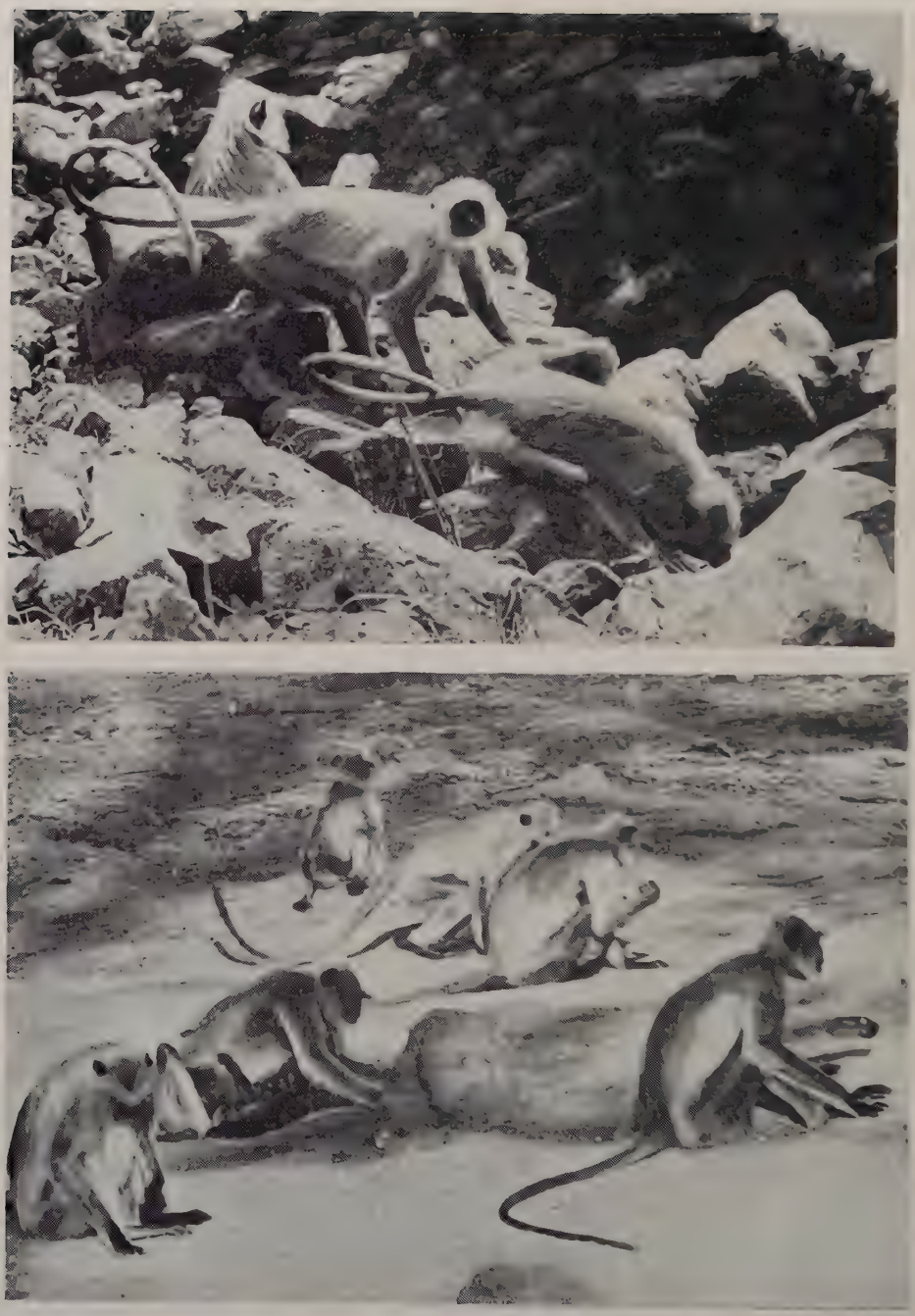
Summaries of sight records, counts and other observed details are provided at the start of the section on each species studied.

Ecological Slants of the Survey

The circumstantial factors influencing the mammalian wildlife of the areas studied, such as terrain and vegetation (as providing cover and food), as well as the habits of the animals, intra- and extra-specific relationships and other details of their life, have been set out in this report based on specific observations as recorded in my field notes, and brief general accounts of certain sanctuaries have been provided in those notes (as

Above : MAHARASHTRA 1968 : TAROBA N. P. : November 16 — about 11 a.m. : Adult female langur — MR. 1 ; *Below :* MAHARASHTRA 1968 : TAROBA N. P. : November 18 — a.m. : A langur mother nursing her young — MR. 2.

(*Photos : M. Krishnan*)



Above : MAHARASHTRA 1968 : TAROBA N. P. : November 22 — around noon : Langur drinking — MR. 4 ; *Below :* M. P. 1970 : KANHA N. P. : March 15 — p.m. : Langur at Sravantal lick. Note black baby — MP. 33.

(*Photos : M. Krishnan*)

already stated). The main features of this report are that it is documented with contemporaneous, on-the-spot photographs, and that both in the field notes and in the report an attempt has been made to study the human biotic factors, generally noticed in ecological reports mainly when they are acutely and overtly hostile (as when poaching or hunting is an appreciable factor), in their entirety, taking all relevant aspects (some insidious or covert) into consideration. The repercussions of forestry and other operations, large-scale projects in and around faunal areas, and of other human activities in and around sanctuaries (such as cattle grazing and the collection of forest produce) on the native uncultivated flora and fauna of the area have been studied and briefly reported. It may be repeated that this is mainly a contemporary report, and that while influences going back to a distant past have not been ignored, prevailing circumstances have been considered.

SOME OF THE STUDY AREAS

Kerala

Periyar Sanctuary

Relevant aspects of the history of the sanctuary: In any appraisal where human influences on the native wildlife are taken into consideration, certain aspects of the history of the Periyar Sanctuary become relevant and may be set out briefly. The Periyar River was dammed about 1897 mainly as an irrigation project; it was then considered a unique feat of engineering skill, and the project still remains an achievement of considerable magnitude: the object of the design (conceived and executed by Col. J. Pennycuick, R.E.) was to divert the waters of a montane river (the Periyar) emptying itself into the western sea, through a long subterranean channel, into another river having its origins in these hills and flowing eastwards (the Vaigai), so that a vast tract of barren plains land could be irrigated. Subsequently, the project was also converted into a hydroelectric one, i.e., into an irrigation-cum-hydel project. It was never intended as a sanctuary, *ab initio*.

It was only some 30 years ago that the then Maharaja of Travancore, realizing the great scope of the area as a sanctuary and its magnificent beauty, constituted it as a sanctuary. The authorities who originally built the project, in the British days, took infinite pains to do nothing that would spoil the great natural beauty and floral and faunal wealth of the area. Nothing artificially obtrusive, no modern facilities and no exotic plants, were known in the area in those days. However, it should be noted that since the project was developed as an irrigation-cum-hydel project, as the result of co-operation between the Madras Government and the Maharaja's Government, certain vested human interests, whose influence on the fauna and flora was not even considered, came to establish themselves in the present sanctuary area, and all around it. Inside the sanctuary, the Madras Government has control over the many-armed lake created by the damming of the river (on a 999-year lease) and the Kerala Forest Department over the extensive forests around the lake. These two government authorities are not the only ones with vested interests in the area: several tribals, now organised into a few settlements, had interests here (mainly in its floral and faunal resources) and their interests were, and are, antagonistic to the wildlife. Further, there are

some private holdings of land within the sanctuary, and any number of estates and plantations all round.

In recent years another human authority has developed interests inside the sanctuary, the Kerala Tourist Corporation, a public limited company which caters to the tourists, mainly to the foreign tourists. There are also other private agencies.

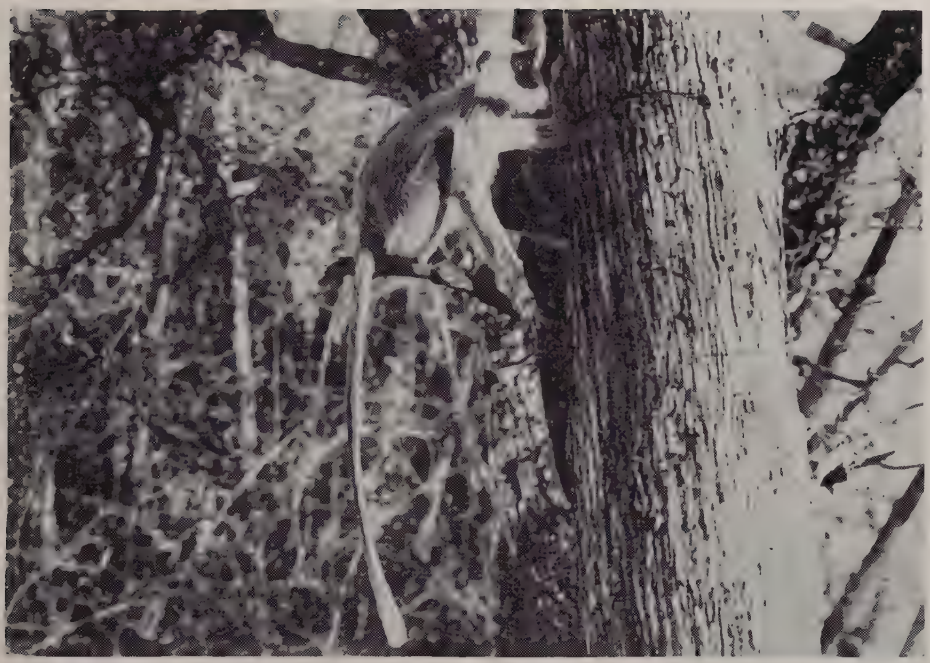
Location and extent: Periyar Sanctuary (Thekkady) is not far from the borders of Kerala and Tamil Nadu along the Madurai border of the latter. The extent of the sanctuary is 304 sq. miles and of the lake, its main attraction, variable from about 10 to 12 sq. miles. The maximum level of the lake is 2860 feet above MSL.

Terrain and environmental factors: The sanctuary is part of an even vaster mixed deciduous forest with a decided evergreen character in many places, and is hilly, varying in elevation from about 3000′ to 6000′. Rainfall varies but is generally heavy, and there are many creeks and swampy flats. The brief floristic account that follows will be indicative of the edaphic and climatic factors obtaining, and the historical note of its biotic (human) environmental factors. The peripheral forests of the sanctuary have been much depleted in recent years by their exploitation for various purposes. During summer, the lake and its ramifications offer the main source of water to the animals.

Floristics: The most interesting floral feature of the sanctuary is not its actual composition so much as the ecological changes induced by the artificial formation of the reservoir and waterspread, by the pent-up waters banking against the hillslopes which, by their very steepness, could have had no source of water originally except during the rains. No study of these changes has been made but it is apparent that at least certain waterside plants such as *Ochlandra* spp. and some sedges, could not have been found in such profusion on the hillslopes and terraces abutting the water before the formation of the lake.

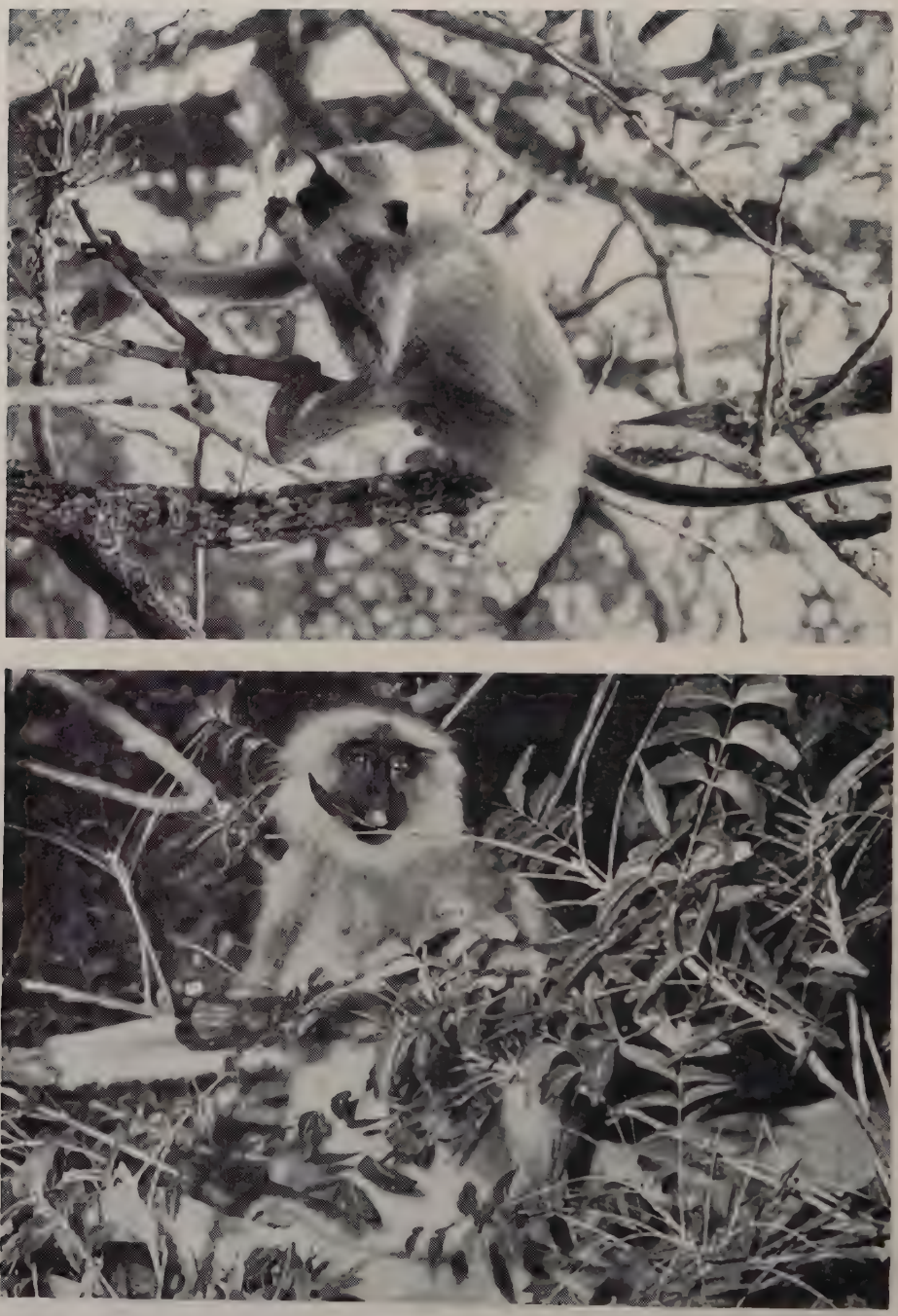
The introduction of exotics into the area has also considerably affected the floral ecology of the sanctuary in places. Near the dam, the hilltops have been extensively planted up with *Eucalyptus grandis*. Lantana has spread thickly in places, as near Aiyappankurukku. *Eupatorium glandulosum* has, recently, established itself in the area.

However, the integrity of the flora of the inner reaches has changed little in the past few decades. The sholas still retain their peculiar, semi-evergreen nature. Many of the trees found in them are either peculiar to Kerala or attain their best development hereabouts; examples are *Gluta travancorica*, *Dipterocarpus bourdilloni* (other Dipterocarps also occur here—*Hopea parviflora* and *H. wightiana*, & *Vateria indica* should be mentioned), *Xylia xylocarpa*, *Poeciloneuron* sp., *Dysoxylum malabaricum*, (*D. beddomei*, and *D. ficiforme* also). Besides these, other important trees of the area that should be mentioned are: *Artocarpus hirsuta*, *Stereo-*



Above: TAMIL NADU 1966 : MUDUMALAI SA. : Kargudi : April 2 — p.m. : 'Rogue' male langur — TN. 43 ; *Below:* M. P. 1968 : KANHA N. P. : May 7 — a.m. : Langur near the rest-house — MP. 8.

(*Photos : M. Krishnan*)



Above: TAMIL NADU 1962 : MUDUMALAI SA. : Kargudi : March 30 — p.m. : Langur eating flowers of *Radermachera xylocarpa* — TN. 17 ; *Below :* MAHARASHTRA 1969 : TAROBA N. P. : November 29 — 5.45 p.m. : Langur eating neem foliage — MR. 15.

(*Photos : M. Krishnan*)

spermum sp., *Terminalia* spp., in particular a variety of *T. tomentosa* where the bark is not conspicuously fissured, *Adina cordifolia*, *Lagerstroemia lanceolata* and *L. speciosa*, *Messua ferrea*, teak, *Lophopetalum wightianum*, *Mangifera indica*, *Pterocarpus marsupium*, *Calophyllum tomentosum*, and *Tetrameles nudiflora*. Teak is common in the deciduous areas. Most of the tree-stumps that are now to be found in the lake, sound in their wood though deeply pitted by time and the elements, belong to the hardwoods in the list above.

In the shola and other tree forests, the undershrub is often fairly open and seldom thorny. The hilltops are of the peculiar nature, clad mainly with herbaceous plants, termed 'downs' in the Nilgiris. While many grasses, both short and tall, are the dominant components of these downs forests, there are a great many other herbaceous plants besides them, including plants of the order Cyperaceae. The main grasses are: *Apluda mutica*, *Arundinella holcoides*, *Cymbopogon citratus*, *Eragrostis gangetica*, *Hackelochloa granularis*, *Paspalum scrobiculatum*, *Panicum repens* and *P. montanum*, *Themeda cymbaria* and *T. triandra*.

Tamil Nadu

Point Calimere Sanctuary

Location, extent and general character: Point Calimere is on the eastern coastline of the Thanjavur District, where the coast projects in a sharp nose into the sea, so that the sea runs more or less north and south of its pointed tip. The sanctuary consists of the coastal reserved forest, of about $7\frac{1}{4}$ sq. miles of the 'Kodiakadu Reserved Forest' as per the Government Notification constituting the sanctuary in June 1967.

The English name 'Kodiakadu R.F.' used in official records appears to be a distortion going back to the British days: the Tamil name is 'Kodi-k-kaadu', 'the farthest forest', and in this note the name will be spelled 'Kodikadu'.

The main faunal feature of Point Calimere is its great assemblies of flamingos and other water-birds in the swampy lagoon. This lagoon, called the Great Swamp, is very shallow and miry, and can be traversed by a Masula boat along certain routes. There are a few islands in the lagoon, one at least large enough for the semi-feral ponies to be grazed in. Misled by a report about mammalian predators preying on the water-birds, much time and effort was wasted in trying to trace them, but it now seems clear that the report was without basis.

Apart from its bird life, Point Calimere Sanctuary (the Kodikadu area) is notable for two main reasons. Agriculture here has been so much frustrated by the animals (pig, horses, cattle and perhaps chital) raiding the crops, that only tobacco, which the animals do not touch, has been

raised. The second point of interest is that most of the mammalian species inhabiting the sanctuary appear to have been introduced. The ponies and cattle are definitely introduced, though some of the cattle have now run wild and are, unlike the ponies, beyond recapture. The chital have been introduced and the pig seem feral. The bonnet monkeys are known to have been brought into the area in April 1965. The truly indigenous mammals of the area (among the larger animals) appear to be the blackbuck, the jackals, and the mongooses on land and the dolphin in the sea around.

There are no large predators. Leopards do not occur in the area. Jackals and mongooses seem to represent the only predators on the land.

The area is sandy along the coast, and in the forest away from the beach, undulating, densely clad with bushes and stunted trees, but with many paths through the forest, and much frequented by humanity grazing cattle: there is a colony of aborigines inside the forest. The commonest animals here are the cattle let loose in the jungle to graze, to fend for themselves; cattle which have become dry or are otherwise unprofitable to their owners are let loose in the forests, and recaptured as needed. The 'feral ponies' too, are owned and branded (as foals) but appear to be semi-feral, as they are no longer in demand as they were formerly.

Official statistics give the total numbers of blackbuck and chital in the area in several hundreds.

During December, when I visited the sanctuary, there were ample reserves of freshwater to the animals in ponds, ditches and hollows. Being coastal, the forests are exposed to storms and heavy rains. In summer, I understand the water available to the animals is limited to a few ponds inside the forest.

Floristics: The vegetation along the coast is very similar to the vegetation of other sandy beaches on the south-eastern coastline, consisting mainly of the following:

Spinifex squarrosus close to the sea on sand dunes: a few grasses (among which are *Cynodon dactylon*, *Chloris barbata* and *Eriochloa procera*) on the beach away from the sea; here and there, close to the sea, patches of *Salicornia brachiata* and *Suaeda monoica*; *Cyperus rotundus* on the beach and sandy flats. Herbaceous vegetation of sandy flats: *Launea* sp., *Lippia* sp., *Oldenlandia umbellata*; *Evolvulus alsinoides*, *Ipomoea pes-caprae*; *Prosopis juliflora*, introduced into the area some 20 years ago, has now spread into the forest away from the shore. A casuarina and an eucalyptus plantation have claimed part of the natural forest. Other exotics in the area are *Vinca rosea*, *Croton sparsiflorus* and *Tribulus terrestris*: in other words, the influence of exotics here is still negligible.

Hedges and brakes of pandanus have been planted, and other species introduced into the area are *Albizzia lebbek* and *A. amara*.

The forest features these tree species: *Mimusops hexandra, Memecylon edule, Zizyphus mauritiana* & *Z. oenoplia, Pongamia glabra, Dichrostachys cinerea, Atalantia monophylla, Calophyllum inophyllum* (planted probably, in a few places near the sea); *Acacia arabica, Canthium didymum*, near the lagoon *Excoecaria agallocha* and *Avicenna officinalis. Morinda tinctoria, Randia dumetorum* rare. *Thespesia populnea* and *Pithecolobium dulce* (rare).

There are many shrubs, chief among them the following: *Clerodendrum inerme, Cassia auriculata, Carissa* spp., *Toddalia aculeata, Capparis sepiaria, Acacia intsia. Leucas* sp. in patches inside the forest. The flora is similar to that of the coast of Tamil Nadu.

Mudumalai Sanctuary

Location, extent and general character: Occupying a vast undulating hillside on the north-eastern slopes of the Nilgiris, in south-east Wynaad, the Mudumalai Sanctuary is one of the few areas in the country specially blessed by nature with a rich and varied terrain, flora and fauna, and has long been celebrated among hunters (*vide* SPORT IN THE NILGIRIS AND ON THE WYNAAD by F. W. F. Fletcher—1911). It has had a chequered political history, having been held by Kerala and Mysore in the past. For reasons stated in the General Account of the Bandipur Sanctuary, the area of the Mudumalai Sa. (about 125 sq. miles or 320 sq. km.) cannot be considered faunally or florally or territorially distinct from Bandipur, or from the peripheral forested areas of Kerala, Mysore, or of Tamil Nadu itself. The entire area of about 250 sq. miles is one vast and varied stamping ground to the animals and one continuous vegetative tract, in spite of its great variations and political demarcation into the territories of Kerala, Tamil Nadu and Mysore and into the 2 main sanctuaries of the last two States. However, the two sanctuaries hold the major populations of the large wild mammals of the area.

In saying this, it must be remembered that these animal populations are not fixed or entirely resident. Apart from the animals moving around within the 2 sanctuaries to suit seasonal fluctuations and needs, the gaur and the elephants wander over forests outside the 2 sanctuaries as well. The deer are more restricted in their movements and may be considered resident, broadly speaking. The langur and bonnet monkey populations are also probably local, the leopards seem localised, but the tigers and wild dogs probably cover much ground.

Terrain and environmental factors: As said, the sanctuary displays considerable variations of terrain and flora. These differences are not based on differences in elevation so much as on topographical variations, the sanctuary being comprised of hills, hillocks, valleys, ravines, flats, swampy hollows in places, and much cut up by watercourses (rivers,

streams and nullahs). The highest elevation is represented by Markundarai Betta, the top of which is 4154′ high; for the rest, the high elevations are all around 3500′ - 3600′: the lowest elevation, at Masinagudi, is around 2900′.

The Benne and Doddakatti Blocks, towards the Kerala border, have a more evergreen complexion than the rest of the sanctuary: the Mudumalai Block consists of rounded hills with hollows in between, the hollows often being swampy, the kind of terrain designated by the local word 'gadde'. Kargudi is more deciduous, but still close tree forest, and moreover the clearings are choked up with tall grass: Theppakkadu, which features natural teak, is more open, with a floor where the undershrub is generally low. Masinagudi is ravine-cut and flat thorn bush forest, with the canals of the Moyar Project supplying perennial water. The entire sanctuary area is well-watered, with the Moyar and subsidiary streams running through. The average rainfall is around 56 inches.

All over the sanctuary, forestry operations are carried on. Selection felling and clear-felling are limited to one coupe per year, but the logging, transport and sale of timber involves considerable forest area. Further, departmental collections of bamboo, and plantation work, are carried on over many areas. Furthermore, minor forest produce collections of many kinds are made on a wide scale both by departmental and extra-departmental agencies, and include the collection of honey, beeswax, myrobalans, bark-lichen, soapnut, tamarind and deer antlers.

The Moyar Project and its working, the activities of the populations living in the many settlements within the sanctuary, or close by it, (such as at Masinagudi, Theppakkadu and Lower Kargudi), and the claims of 14 private holdings within the sanctuary area, add further to the constant disturbance by humanity that the wildlife face here.

The main motor road from Mysore to Ootacamund, runs through the Mudumalai Sanctuary and cattle destined for the slaughter-houses are herded weekly along this road, in hundreds. These are usually decrepit and sick cattle from which infections might well spread to the wild ungulates. Besides this, great numbers of cattle are grazed in many areas in the sanctuary.

Floristics: The floristic variety of the sanctuary is one of its most important features. However, this variety lies not so much in the differences between plant species peculiar to particular areas or Blocks as in the varying stature and dominance that the same species attain in different areas. *Anogeissus latifolia*, found all over the sanctuary, exemplifies the point. In the Benne and Mudumalai Blocks it attains its best growth and is less gregarious than it is in Kargudi and Theppakkadu, and in Masinagudi it is insignificant both in stature and dominance. Again, while *Randia dumetorum* is widespread in the drier areas, it is *R. uliginosa* that is found in moist localities, often along with *Careya arborea*. Along nullahs and streams, brakes of pandanus and *Ardisia solanacea*

occur, and along rivers and major watercourses mango, *Syzigium* spp. and other evergreens, and figs. *Phoenix humilis* is common in swampy flats and in clearings, and belts of tall grasses and of bamboo are dominant in certain localities. The bamboo of the sanctuary is *Bambusa arundinacea.*

Among the main tree species of the sanctuary, the following may be mentioned: those typical of particular localities are mentioned under those areas:

Adina cordifolia; *Albizzia procera* & *A. odoratissima*; *Anogeissus latifolia*; *Bauhinia racemosa*; *Bischofia javanica*; *Bombax ceiba*; *Bridelia retusa*; *Buchanania latifolia*; *Canthium parviflorum*; *Careya arborea* in moist localities; *Cassia fistula*; *Cedrela toona* in the elevations; *Dalbergia latifolia*; *Diospyros melanoxylon* & *D. montana*; *Elaeodendron glaucum*; *Emblica* spp. (in the recent revision of the genus, some 4 or 5 species have been assigned to the area, and no taxonomic determination of these by a competent worker has been done so far); *Erythrina indica*; *Ficus bengalensis* & *F. mysorensis*; *Gardenia* spp.; *Garuga pinnata*; *Gmelina arborea*; *Grewia tiliaefolia*; *Kydia calycina*; *Lagerstroemia lanceolata* & *L. parviflora*; *Machilus macrantha*; *Madhuca latifolia*; *Mangifera indica*; *Mitragyna parviflora* along streams; *Ougeinia dalbergioides*; *Premna tomentosa*; *Pterocarpus marsupium*; *Pterospermum rubiginosum*; *Radermachera xylocarpa*; *Randia dumetorum* & *R. uliginosa*; *Santalum album* (Kargudi, Theppakkadu mainly); *Schleichera oleosa*; *Schrebera swietenioides* (distinctive of the Wynaad); *Semecarpus anacardium*; *Shorea talura*; *Stereospermum tetragonum*; *Syzigium* spp.; *Tectona grandis*; *Terminalia bellerica*, *T. tomentosa* & *T. chebula*; *Trewia nudiflora* in moist localities; *Vitex altissima*; *Zizyphus mauritiana*; *Z. oenoplia*, *Z. trinervia* & *Z. xylopyrus.*

Pandanus sp. and *Phoenix humilis* occur in moist localities and in open flats (usually swampy) respectively. *Dioscorea* spp. and other corms occur all over the sanctuary. Among the twiners may be mentioned *Smilax aspera.*

Among the shrubs of the forest floor should be mentioned: *Abutilon indicum*; *Ardisia solanacea*; *Butea parviflora* (more often found as a flat-spread patch on the forest floor than ascending the trees); *Desmodium* sp.; *Flemingia bracteata*, *F. grahamiana* & *F. wallichii*; *Grewia hirsuta* and *G. aspera*; *Helicteres isora*; *Hibiscus lampas*; *Indigofera* sp.; *Limonia alata*; *Pavetta indica*; *Triumfetta pilosa*; *Toddalia aculeata.*

A variety of tall grasses and a few short grasses, and a great many herbs constitute a most valuable source of fodder to the animals. I was unable to get the grasses identified precisely.

A number of epiphytic orchids are found in the Kargudi-Mudumalai area. Mushrooms, puffballs and ledge-fungi of many kinds are found all over the sanctuary, many of them edible.

In the Benne and Mudumalai Blocks the trees attain their best development, and there is a greater admixture of evergreen species in these blocks, though in the north-eastern reaches of Mudumalai the trees are stunted, featuring small-sized *Anogeissus latifolia*, *Shorea talura*, *Soymida febrifuga* and *Terminalia chebula*. Elsewhere in the Mudumalai Block, where the tree forests are tall, *Mussaenda tomentosa* is sometimes prominent in the undershrub.

While the giant bamboo (*Bambusa arundinacea*) is widely distributed in the sanctuary, it occurs in large gregarious belts in Benne, and a notable feature of these bamboo belts is that they seeded gregariously in the March of 1959, '63 & '64. *Elaeocarpus serratus* (and other species of the genus), *Sterculia villosa* and *Aporosa lindleyana* are among the trees of Benne, and *Colebrookea oppositifolia* occurs in its undershrub.

The Kargudi Block features many extensive belts of tall grass, rank and choking up the forests in September-October. *Solanum* species are a feature of its undershrub in places (as in C.2) and it is here and in its reaches towards Theppakkadu (as also certain areas in Masinagudi, like the Avarahalla) that lantana flourishes most luxuriantly.

The Theppakkadu Block is distinctive in its flora. Natural teak forests, with gregarious patches of *Anogeissus latifolia* in a few places, are the feature of its tree growth. The forest floor is open, and the shrubs, herbs and grasses that clothe it of low stature in the main (except in a few places where lantana has found a footing). A species of the ground orchid, *Habenaria* is found on the forest floor here: other features of the undershrub are procumbent *Butea parviflora*, *Flemingia* spp., and *Desmodium pulchellum*, and, in moist, flat locations a carpet of 'koovai' (*Costus speciosus*, and perhaps also another plant of the Zingiberaceae) —such patches of 'koovai' also occur in places in Kargudi. Apart from teak and *Anogeissus*, no other tree species occurs here gregariously, but among the species typical of the area are *Schrebera swietenioides* and *Eriolaena quinquelocularis* (in fruit in September). Both in Theppakkadu and in Masinagudi, *Argyreia fulgens* is a feature of the undershrub (and in Masinagudi, of open spaces) with its dark purple flowers.

Masinagudi is even more distinctive floristically, featuring a great many spiky shrubs and thorny trees and climbers. *Acacia intsia*, *A. concinna*, *A. ferruginea* and *A. catechu*, all the thorny species of *Zizyphus*, *Capparis* spp., *Gymnosporia montana*, *Toddalia aculeata*, and *Canthium* spp. are features of its flora, as also *Givotia rottleriformis*, and an erect tree-like *Euphorbia*.

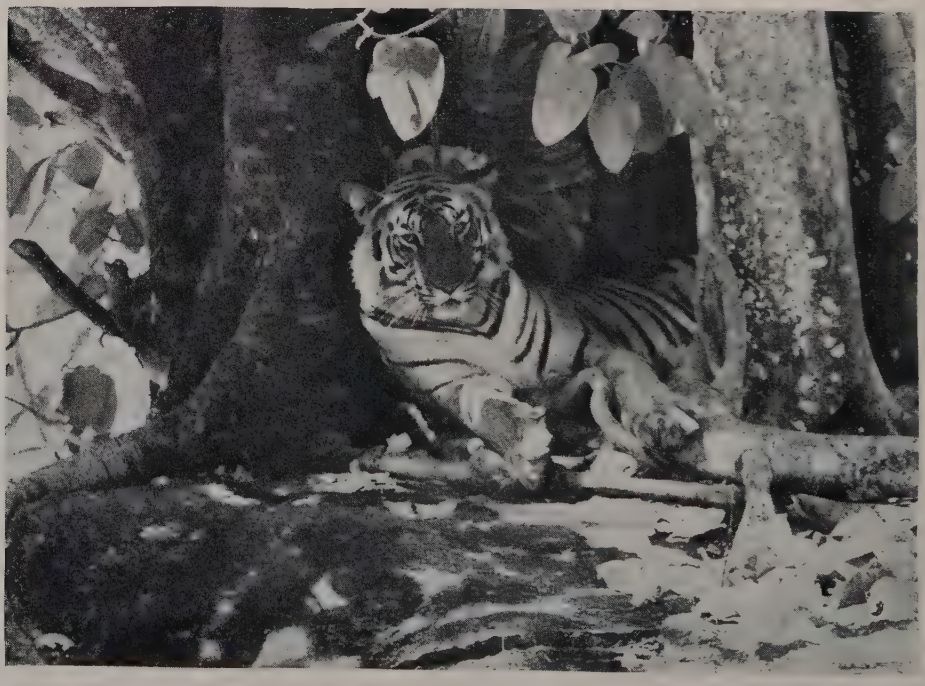
Mysore

Bandipur Sanctuary

Location and extent: The Bandipur Sanctuary (23 sq. miles or 60 sq. kms.) of the Gundlupet Taluk of Mysore is the heart of the Venu-

Above : M. P. 1968 : KANHA N. P. : May 4 — a.m. : The larger of the two subadult tigers — MP. 4 ; *Below :* M. P. 1968 : KANHA N. P. : May 6 — a.m. : Portrait of the larger subadult tiger — MP. 7.

(*Photos : M. Krishnan*)



Above : M. P. 1968 : KANHA N. P. : May 8 — a.m. : The tigress on the rock — MP. 9 ;
Below : M. P. 1968 : KANHA N. P. : May 11 — a.m. : The tigress in the corridor between the bole of the banyan and a pillar root — MP. 10.

(*Photos : M. Krishnan*)

gopal National Park of the old princely State of Mysore and is contiguous with the Mudumalai Sa. of Tamil Nadu along a wide border, along the Kakkanhalla and the Moyar. It lies to the east of the Doddakatti Block of the Mudumalai Sa., to the north-east of its Mudumalai Block and to the north of its Theppakkadu Block. The Moyar and the Kakkanhalla are fordable at many places along the Bandipur-Theppakkadu border, so that the animals commute freely between the two sanctuaries.

Terrain and environmental factors: Bandipur is not much lower in elevation than most places in the Mudumalai Sa.: these figures from the Survey of India topo-sheet No. 58A/10 (one inch to the mile) will prove this statement: Bandipur Sa.: Lodges—3265′; Mulapura Betta: 3768′; Mudumalai Sa.: Upper Kargudi—3270′; Lower Kargudi—about 2900′; Mudumalai—3285′, Theppakkadu—3050′. However, Bandipur gives the casual visitor the impression of a lower elevation because it is comparatively much less undulating in its topography, and flatter, and its forests are more open and the undershrub less dense and high. It should be appreciated that Masinagudi and its surroundings, set against the backdrop of the Nilgiris, is actually on a lower elevation than Bandipur, and that the Moyar reserved forests extend on both sides of the river into Mysore and into Tamil Nadu. There is not much difference in rainfall (average about 56″ for the Mudumalai Sa.) but apparently edaphic factors differ, and the more uneven ground of the Mudumalai Sa., cut up by many watercourses, is more conducive to tree growth, the same species rarely attaining in Bandipur the stature they do in the Tamil Nadu sanctuary.

A notable feature of Bandipur is its many clearings holding short grass, which, except in summer, have a lawn-like greenness. Bandipur is much less spiky in its underbrush than certain areas of the Mudumalai Sa. (the Masinagudi area in particular) and holds much less tall grass: being only about 1/6 the size of the Tamil Nadu Sanctuary, it is a closer-knit area and more homogenous in character. Moreover, a notable feature of the area is the number of forest pools and tanks, natural and artificial, that it has, such as Tavarakatté, Kollakumalikatté, Kari Gowdana Katté, Aralikatté, Baisnapur Keré and Moolapura Keré. These provide the wild animals (and also the cattle) with water, and attract elephants and gaur when they hold water.

In spite of these differences, both from the point of view of the faunist and of the fauna, the Bandipur Sa. can only be considered a continuation of the Mudumalai Sa. (or the other way around) and territorially and floristically it is closest to the Theppakkadu Block of the Tamil Nadu Sanctuary, though lacking the flow of the Moyar right through it as at Theppakkadu. It also has points of resemblance to Masinagudi in its fauna and flora. A further point of resemblance between Bandipur on

the one hand, and Masinagudi and Theppakkadu on the other, which is of importance to any ecological faunal study, is that in both there are abandoned forts, human settlements, and shrines, where the forest has reclaimed human settlements. In Bandipur, the presence of tamarind and banyan trees often marks these locations.

Perhaps the most notable feature of the Bandipur Sa. is that it is almost unique in India in that no forestry operations are permitted in it. To appreciate how vastly this has contributed to the faunal wealth of the sanctuary it is necessary to point out that in spite of privileged shikar being allowed in and around Bandipur, in spite of the extensive grazing of cattle in the sanctuary and the free exercise of village rights, the same animals (chital in particular) are much less shy of humanity in Bandipur than in the Mudumalai Sa.

Floristics : As mentioned, the tree species here do not attain a notable stature and the canopy is generally not too high. The forest floor is fairly open, and the clearings are covered with short grasses : there are also clearings holding tall grasses and hillside flats and slopes covered with herbaceous pasture. The comparatively open nature of the tree forests and the undershrub, are factors that are of great faunal importance.

The main tree species include the following : *Acacia intsia, A. concinna* and *A. ferruginea* (not dominant—nowhere near as common as in Masinagudi in the Mudumalai Sa.) ; *Albizzia lebbek* ; *Anogeissus latifolia* ; *Bauhinia latifolia* ; *Buchanania latifolia* ; *Butea monosperma* ; *Canthium parviflorum*; *Careya arborea* in moist areas; *Cassia fistula*; *Dalbergia latifolia* ; *Diospyros montana* ; *Elaeodendron glaucum* ; *Emblica* spp.; *Ficus bengalensis* and *F. mysorensis* ; *Gardenia* spp. ; *Garuga pinnata* ; *Givotia rottleriformis* (less common than in Masinagudi); *Grewia tiliaefolia* ; *Holarrhena antidysenterica* ; *Kydia calycina* ; *Lagerstroemia parviflora* and less commonly *L. lanceolata* ; *Machilus macrantha*; *Morinda* spp. ; *Ougeinia dalbergioides* ; *Premna tomentosa* ; *Randia dumetorum* ; *Shorea talura*; *Syzigium* spp. ; *Terminalia bellerica* and *T. tomentosa* ; *Vitex altissima* ; *Zizyphus xylopyrus, Z. trinervia* and *Z. mauritiana.* Tamarind, mango and wood-apple in places.

The main bamboo of the area is *Bambusa arundinacea* but *Dendrocalamus strictus* is also found. In places *Phoenix acaulis.*

The main shrubs are : *Anona squamosa, Flemingea* sp., *Gymnosporia montana*; *Grewia hirsuta* and *Grewia aspera*; *Helicteres isora*; *Indigofera* spp. ; lantana in places ; *Limonia alata* ; *Pavetta indica* ; *Solanum* spp. ; *Toddalia aculeata.*

The herbaceous vegetation is rich, particularly in September-October. No identification of the grasses was possible.

Above : M. P. 1968 : KANHA N. P. : May 11 — p.m. : 'Bade Ma' — MP. 11 ; *Below :* M. P. 1968 : KANHA N. P. : May 12 — a.m. : The tigress in a pool — MP. 12.

(*Photos : M. Krishnan*)

Above : BIHAR 1969 : BETLA : PALAMAU : February 17 — p.m. : Adult gaur cow killed by a tiger — B. 11 ; *Below :* MAHARASHTRA 1968 : TAROBA N. P. : November 25 — about 7 p.m. : A big male leopard — MR. 6.

(*Photos : M. Krishnan*)

ANDHRA PRADESH

Kawal Sanctuary

Terrain and floristics :

The forests around Birsaipet and the surrounding areas are said to be the best in the sanctuary. The ground is undulating, rocky in places, and with a few pools holding water in November. In most areas teak predominates, constituting about 60% of the tree forests ; the other main species noticed were *Chloroxylon swietenia, Terminalia tomentosa, T. bellerica, T. chebula* and *T. arjuna* (the last near water), *Acacia sundra* (*catechu*), *A. leucophloea* and *A. arabica, Albizzia lebbek* and another *Albizzia*, probably *procera, Butea monosperma, Cochlospermum religiosum* and *Sterculia urens*, both in yellow, falling leaf and both with remarkably straight boles, *Careya arborea* here and there, *Zizyphus xylopyrus, Z. oenoplia* & *Z. mauritiana, Lannea grandis* (uncommon), *Boswellia serrata, Madhuca latifolia, Pterocarpus marsupium* (in flower), *Bauhinia racemosa, Dalbergia paniculata*, and *Emblica* spp. (*E. officinalis* & perhaps another species).

In many areas the 'male bamboo', *Dendrocalamus strictus*, grew gregariously or in clumps amidst the trees, and was in a very leafy and lush phase—the culms here are hollow.

In some places teak was sparse or absent, and in such places *Chloroxylon swietenia* and *Boswellia serrata* were prominent; in places *Cleistanthus collinus* grew gregariously and dominated the vegetation.

The undershrub was very thick and luxuriant, and consisted mainly of regenerating teak and gregarious regenerating *T. tomentosa* and other trees—evidently the forests were clearfelled some years ago. *Butea superba* was also prominent in the undershrub. Inside the tree forests there was little grass, though in clearings there was grass, and there were areas where thatching grass grew in abundance.

The forests were dense rather than open, the undershrub in particular being thick. There were paths in a network, overgrown with vegetation in most places in November. I learnt that in summer the forests are much more open and 'negotiable'.

Pakhal Sanctuary

Pakhal Sanctuary features a beautiful lake, which has its own wildlife (mainly birds, and crocodiles in one of its reaches). The forest is fairly thick, of a mixed deciduous nature, and holds trees of faunal importance such as *Emblica* spp., *Gmelina arborea, Careya arborea, Bridelia retusa, Terminalia bellerica*, and mohwa. The undershrub is notable for its comparative scarcity of herbs and grasses and holds many shrubs of

faunal importance such as *Helicteres isora*, and *Grewia* spp. Eturnagaram has a richer tree growth and features belts and patches of grasses; the forest floor here is generally less shrubby and more herbaceous.

Both sanctuaries are in the process of being rehabilitated after being much depleted by years of intensive hunting and poaching—indeed, this is true of all sanctuaries in Andhra Pradesh, and while this is true to some extent of all Indian sanctuaries, I feel that the wildlife of Andhra Pradesh is best assessed or investigated after a fair period of the restorative effort. From the point of view of floristic ecology, the floral environment is still quite favourable to mammalian wildlife; however, the biotic (human) environmental factors may change very considerably, after a comparatively recent period of acute hostility.

Bihar

Hazaribagh National Park

History of the recent past.

Hazaribagh today is one of the best-forested districts in Bihar, some 45% of the total area being forested. Nevertheless, its floral history is one of sustained devastation.

Haines, in his BOTANY OF BIHAR AND ORISSA (1925) cites the District Gazetteer of 1917 which contains a note on the flora of Hazaribagh (and Monghyr) by the Rev. S. L. Thompson, formerly Principal of St. Columba's College, Hazaribagh. The following passage from that note of 1917 is significant: 'Unfortunately no report on the Hazaribagh flora can omit the most striking fact about it, i.e., its rapid disappearance. The forest is being most wastefully destroyed, and with it a great number of plants of great botanical and economical value are becoming extinct .... where even ten years ago there was considerable jungle.' (p. 70, Introduction, BOTANY OF BIHAR AND ORISSA by H. H. Haines).

Subsequent to 1917 the devastation continued, though certain areas in the present National Park, then the game preserves of the Raja of Ramgarh, were strictly protected and preserved intact. When this zamin forest was taken over about 1948, except for these protected game reserves of the Raja, the rest of the forest was heavily burdened with human rights (right to collect fuel, small timber and mohwa flowers, and to graze cattle), and there were quite a few villages inside the sanctuary area. Those villages are still there, and no doubt they are no singular exception to the stupendous population increase that has overtaken the country during the past 20 years. Considerable tracts of the forest have been ceded to agriculturists following the taking over of the ex-zamin forests, on a Government decision to cede to agriculture all land bearing traces of

the plough. Today, even in those areas which were strictly protected prior to 1947, cattle are grazed and fuel collected. Although fuel collection is intended to be limited to dead wood, in actual fact live trees are also cut for fuel, on the sly.

The fauna had also been greatly depleted when the forest was taken over by the Government, and inquiry of many people who knew the forest then reveals that few animals could be seen, even at night.

Terrain and general factors : The extent of the National Park is about 75 sq. m.

Hazaribagh consists of an undulating plateau, of broad, mound-like elevations with broad, shallow depressions in between, cut up by nullahs, and clad in sal and a deciduous tree forest, with an undershrub rich in herbs. The soil is porous, sandy along the nullah, and except in depressed, shallow basins of clay neither the topsoil nor the subsoil is capable of retaining water. Because of this rapid drainage, and not because of poor rainfall, water is a major problem for man and beast during summer.

The climate is cool and dry, and I am told that during the cold weather Hazaribagh is now the coldest place in Bihar, though formerly Ranchi was. Arriving here very early in February when the days were brilliantly sunny, I noticed that even the natives wear shawls and blankets during the day.

A National Highway runs through the National Park, and only the area to one side of it (from Pokharia gate to Rajderwa) has been properly developed as a National Park, though 2 watch-towers have been built on the other side, too.

The most notable biological factor of the area is that during the day there are people all over the forest, collecting firewood, grazing cattle and passing through ; man is much the commonest diurnal animal of Hazaribagh, the wild animals being nocturnal and crepuscular, mainly in consequence of this disturbance by men.

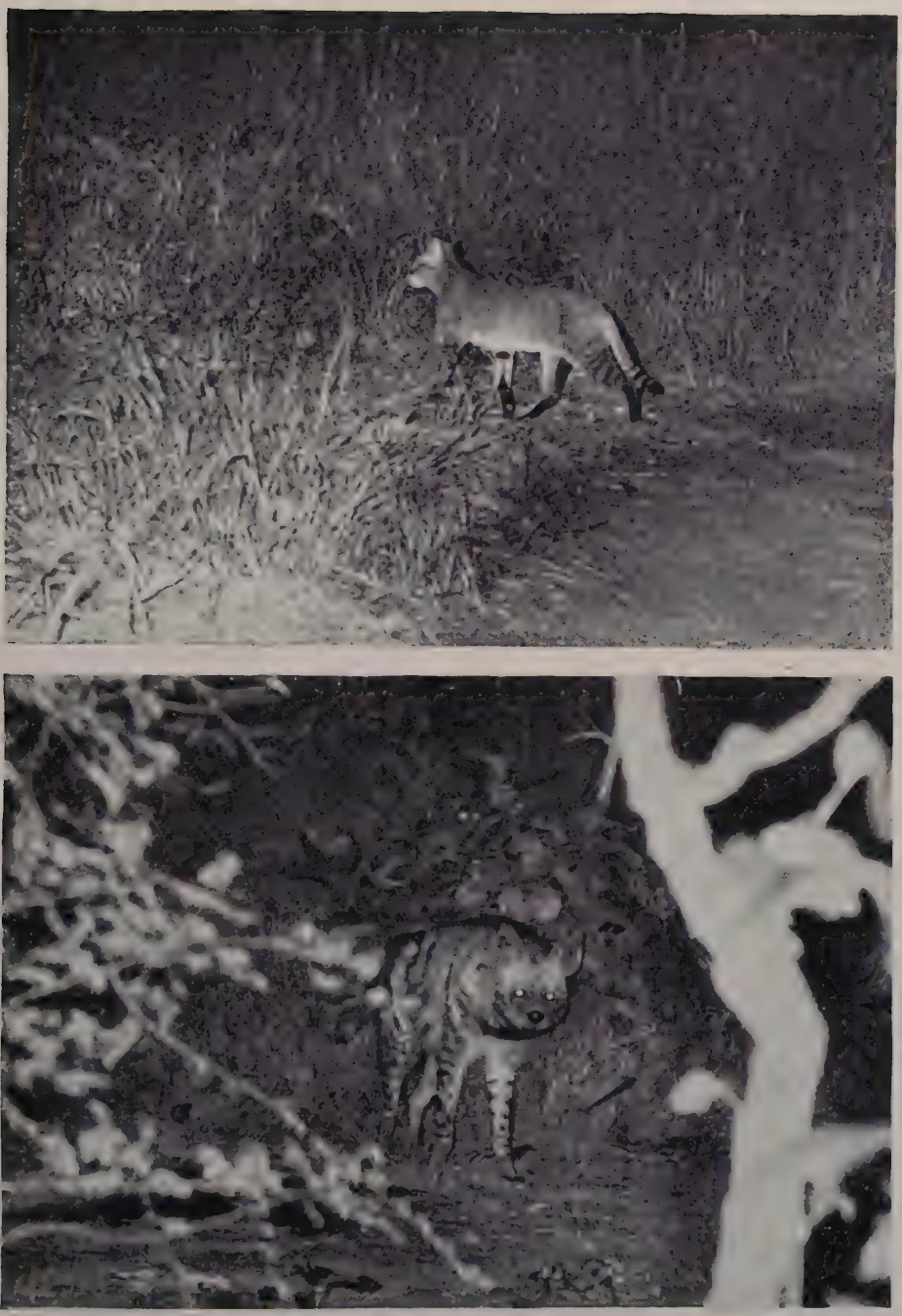
Although territorially distinct, it should be realized that the Hazaribagh forest (National Park forest) is only a part of the forest complex around it, and that the forest is very similar in composition and complexion in outlying areas, like Kodarma and Gomia. The animals no doubt commute between the protected and unprotected areas, but tend to concentrate in the former, the incentive for this being mainly the protection they gain here.

Flora

Hazaribagh is mainly a sal forest, but not a sal forest where *Shorea robusta* dominates all else, as in the Simlipal hills of Orissa ; the sal at Hazaribagh, cut down in the past, is now in a regenerating phase, and is

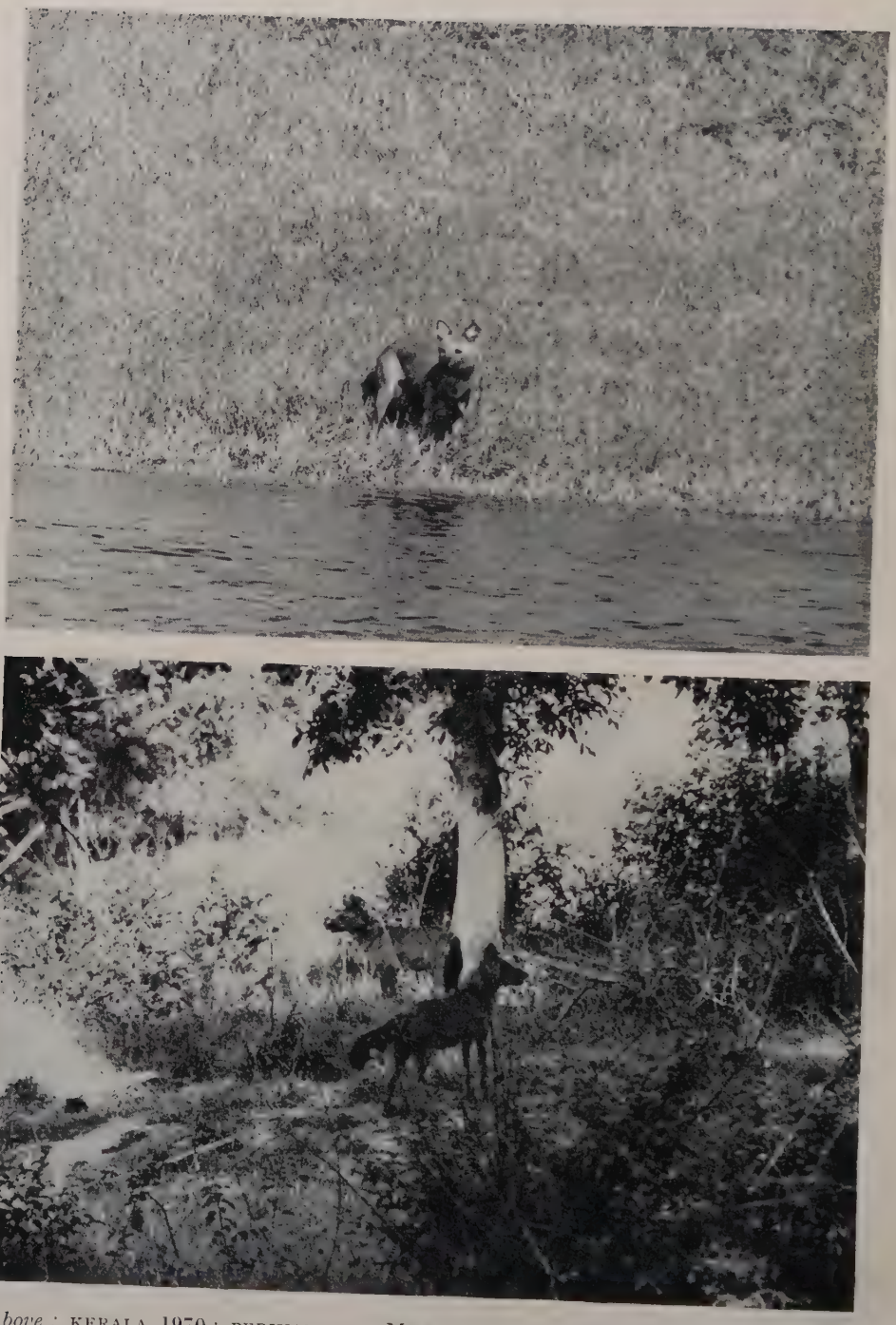
associated with a number of deciduous species, which grow along with and independently of it, in patches. Besides sal, which occurs in patches rather than in continuous belts, these are the main tree species.

Acacia catechu: Khair. Commoner away from sal, along the nullahs especially, than in the sal patches. Common in clearings; *Adina cordifolia:* Not common. Formerly commoner, as evidenced by old floras; *Aegle marmelos:* more young trees seen than old ones. A tree of great faunal importance; *Ailanthus excelsa:* formerly very common, as evidenced by old floras. I saw very few; *Anogeissus latifolia:* here and there in the interior. Saw no gregarious patches of it, as I have seen elsewhere; seems to have been commoner formerly; *Bauhinia* sp.: Bauhinias are quite a feature of the forest. Among tree species, there seem to be several, none in flower when I saw them. *B. racemosa* and *B. purpurea*, and one or two others occur here. The liana, *Bauhinia vahlii* is very common here; in fact, I cannot recall any other forest area in India where it is so common. I noticed that here, too, it is only rarely or occasionally that it attains to the status of a tree-strangling liana, and that usually it is a harmless, straggling, scandent, low bush, providing lush foliage that is easily accessible; *Bombax ceiba:* The red silk-cotton. In flower in February-March, and therefore conspicuous. Along the nullahs. Attracts a great many birds; *Boswellia serrata: Salai.* Much the commonest tree here, after sal. Forms gregarious stands covering the hilltops, and also grows along with sal and other trees. In flower in March. Deciduous and bare in February; *Bridelia retusa:* Seen occasionally, but probably common in places. Wood seems to be valued as fuel. Saw several branches, with the leaves still on them, being carried by fuel-collecting women on their heads; *Buchanania latifolia:* Very common. In flower in February-March; *Butea monosperma:* Palas. The flame of the forest. Not in flower in February. Less common than in other similar forests in Bihar. The liana, *Butea superba*, also occurs, usually as a flat-spread bush; *Cassia fistula:* Not common. I looked for it in the cleared patches where it is often dominant and could not find it commonly there; *Diospyros melanoxylon:* Sporadic. Said to be common in certain areas. A tree of considerable faunal importance; *Emblica* sp.: Most probably *E. officinale:* Not uncommon. A tree of considerable faunal importance and definitely *not* a 'sal associate'; *Gardenia* spp.: None in flower, when I saw them; *Garuga pinnata:* A tree of considerable faunal importance. Sporadic; *Lagerstroemia parviflora:* Very common. I noticed that all the trees I saw were young ones, and that none had attained to a stature of over 30 feet; *Madhuca latifolia:* The Mohwa. Common. Beginning to flower in February and in profuse flower in March. The animals do not get a chance to eat the flowers as people camp all night under the tree, with fires lighted, to collect the fallen flowers at dawn. An important item of food to the



Above : BIHAR 1969 : HAZARIBAGH N. P. : February 14 — 8.30 p.m. : Jungle cat — B. 9 ; *Below :* BIHAR 1970 : HAZARIBAGH N. P. : February 4 — about 8.30 p.m. : Hyena — B. 23.

(*Photos : M. Krishnan*)



Above : KERALA 1970 : PERIYAR SA. : May 6 — a.m. : Wild dog — K. 28 ; *Below :* MYSORE 1968 : BANDIPUR SA. : October 22 — a.m. : Wild dogs — MY. 11.

(*Photos : M. Krishnan*)

people here. No reason why they should not, as in the South, plant mohwa groves around villages for human requirements. No such plantations in Bihar; *Mallotus philippensis :* Very common, especially away from sal along nullahs—also with sal. In fruit in February; *Nyctanthes arbor-tristis :* Fairly common. Drying up in February; *Pterocarpus marsupium :* This valuable tree was formerly much less uncommon. Only a few small trees seen; *Terminalia tomentosa :* Fairly common. Young, bush-sized saplings in clearings. *T. bellerica* (a tree of considerable faunal importance) is uncommon : *T. chebula* (the myrobalan) less so ; *Semecarpus anacardium.* The bamboo of the area is *Dendrocalamus strictus,* which grows in clumps all over. An important plant, faunally.

Shrubs and herbs : The undershrub and clearings are rich in many plants. I did not try to work out the common spp. for I do not have the botanical knowledge, particularly of the grasses needed. A competent field botanist, with a good herbarium and good floras to aid him, should find Hazaribagh very rewarding.

There are many grasses in clearings, in the undershrub, and along nullahs, short or of medium size, still green in February.

Phoenix acaulis (*Phoenix humilis* ?) is common in clearings and along the nullahs : it seems to be *acaulis,* having no stem, or bole, of any height. This is a plant of faunal importance, both the fruit and the young leaves being eaten.

Among the shrubs may be mentioned *Cassia tora, Carissa* spp., *Flemingea chappar* and probably another species or two, *Indigofera* sp., and *Holarrhena antidysenterica.*

Betla

Palamau National Park

The Palamau National Park of Bihar is in the western part of the Chotanagpur district of Bihar, and is now about 96 sq. miles in extent. However, since I did most of my work in the Betla area of this park, best developed as a sanctuary and only about 12 sq. miles in extent, this note is confined to that area.

Betla consists of dry deciduous forests (plains forests at the foot of low hills) and is very dry in summer (when I was there), though it is almost enclosed between two rivers, the Koel and the Auranga, in which there is always some water. The animals do not move out of the dry area to the riversides or to the better-watered forests around during summer, when both the drought and the heat are severe—some of them, the elephants for example, do, but even the tiger and the chital and the gaur stay on here, finding such water as they can in drying water-holes, puddles

and the few artificially improved hollows. Rainfall averages about 45 inches.

Permanent hides (watch-towers, one, Madhuchuan, a ground-hide) have been built near these sources of water, and observation of the animals, and to a lesser extent photography, is possible from them.

Terrain and floristics : Betla is almost flat, though the hills are close by. The main tree species are *Acacia catechu*, *Adina cordifolia* (in the moister areas), *Aegle marmelos* (quite common), *Anogeissus latifolia* (stunted), *Albizzia lebbek*, *Alangium salvifolium*, *Bauhinia retusa*, *Butea monosperma*, *Buchanania latifolia*, *Boswellia serrata*, *Cochlospermum religiosum*, *Cleistanthus collinus*, *Cassia fistula*, *Chloroxylon swietenia*, *Cordia myxa*, *Diospyros melanoxylon* and *D. montana*, *Emblica* spp. figs, *Garuga pinnata*, *Hymenodictyon excelsum* (in places), *Holarrhena antidysenterica*, *Lagerstroemia parviflora* (stunted), *Madhuca latifolia* (common), *Morinda tinctoria*, *Nyctanthes arbor-tristis*, *Lannea grandis*. *Pterocarpus marsupium* (stunted), *Semecarpus anacardium*, *Syzigium cumini*, *Schleichera oleosa*, *Soymida febrifuga*, *Sterculia urens*, *Terminalia* spp., *Wrightia tomentosa*, *Zizyphus mauritiana*, *Z. xylopyrus* and *Z. oenoplia* figs, and the red silk-cotton, near water.

The forest floor is fairly open, and covered with grass in places. Among the grasses of the area are *Apluda aristata*, *Crysopogon* spp., *Heteropogon contortus*, *Imperata arundinacea* and *Saccharum spontaneum*.

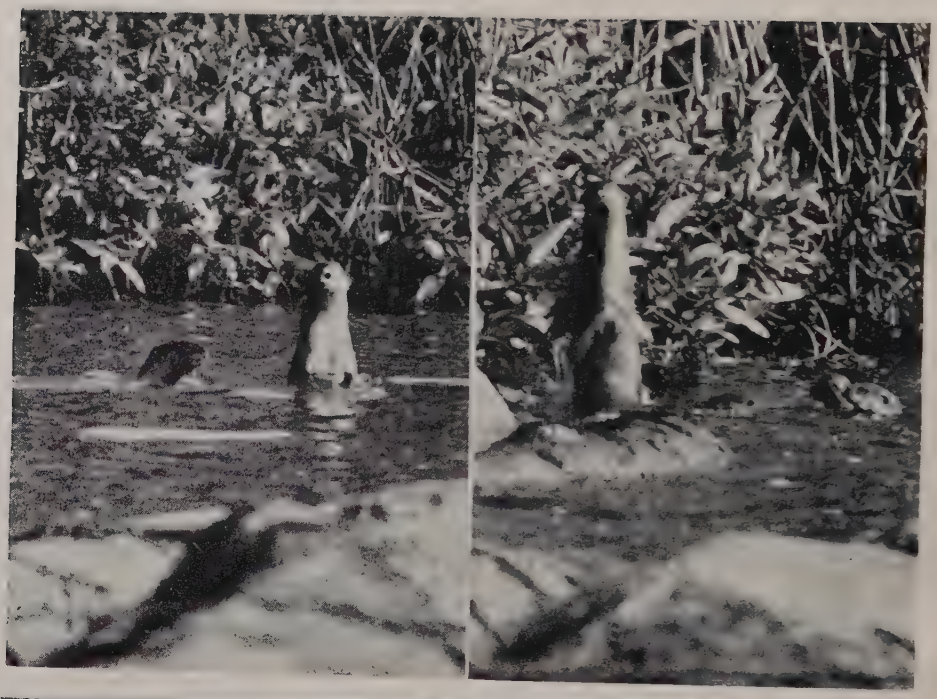
Betla is noted for its bamboo : the bamboo of the area is *Dendrocalamus strictus*.

The grazing of cattle and the collection of thatching grass and firewood is allowed or otherwise indulged in. There are villages around.

The Report of an Ecological Mammalian, Survey of Peninsular India : 1959-70

The factual bases of this report have been fully set out in the field notes, the introduction, and the discussions of each of the 33 mammals observed during the discontinuous 12-year period of the survey, and documented with 242 candid photographs. In the interests of the factual integrity of this study, there has been no attempt at editing or improving the actual record as written up after each day of observation and photography, and pains have been taken to collate the observation notes in the discussion of each species and to correlate them to the interpretation directly without the adventitious aid of graphs, statistical columns and other displayed selective analyses. The photographs have been selected not for their pictorial merit but solely for their evidentiary and record value. Further, brief accounts of the floristic and territorial features of most of the study locations, and references to any climatic factor of special interest, have been provided earlier. When all this has been done,

Above : KERALA 1960 : PERIYAR SA. : April 17 — p.m. : Vultures feeding on a wild dog kill : (sambar) — K. 8 ; *Below :* TAMIL NADU 1962 : MUDUMALAI SA. : Kargudi : March 14 — a.m. Sloth bear eating mohwa flowers — TN. 9.
(*Photos : M. Krishnan*)



Above : KERALA 1959 : Quilon backwaters : June 1 — a.m. : Otters standing up in the water to look and hiss at me — K. 1 ; *Below :* TAMIL NADU 1963 : MUDUMALAI SA. : Kargudi : March 20 — a.m. : Large Brown Flying Squirrel gliding — TN. 23.
(*Photos : M. Krishnan*)

there is neither need nor justification for making the final assessment in this chapter long, and if it seems too brief, it is only because much of what may be detailed here has already been detailed elsewhere in the factual bases specified above, and is not repeated.

The main reason for such a plan is the avoidance, to the extent possible, of personal bias in the assessment of the observation. However, it must be stated that the convictions and experience of many years of faunal and floral observation, and of the factors that influence wildlife in India, have not been ignored, and are also behind this report.

The ecological factors taken into account are not only the climatic, floristic and territorial features, and the inter-relationships of the mammals considered in this report. What is usually termed the biotic factor, i.e., the impact of humanity on wildlife, is of far greater importance than these other circumstantial influences even. This is so overwhelmingly the determining factor in the life of Indian wild animals and plants today, and has been so overwhelmingly so for the past 50 or 60 years, that it must be the main factor taken into consideration in any ecological report on the wildlife of the country. Giving it the importance that is its due, it will be discussed here as the primary factor affecting wild mammals.

Although this is a report of contemporary influences conditioning the life of some of our larger wild mammals, initially it may be noted that some 60 years ago, in the first decade of the century, the repercussions of human activities on the wildlife were not so serious. Not that they had no important impact on the wildlife then—in fact, even then they were the most important conditioning factors, and from all accounts available, even by the middle of the last century hunting, and trapping and snaring, were being indulged in with little inhibition, and the forests were expected (by natural regeneration) to cope with all demands made on them departmentally and by the people. Decline, in the circumstances, would be mainly a measure of the recuperative powers of the wildlife falling short of the depletion by human agency. In those days, apparently, there were many natural forests and other faunal areas not deeply penetrated by men, and the human population was much less dense.

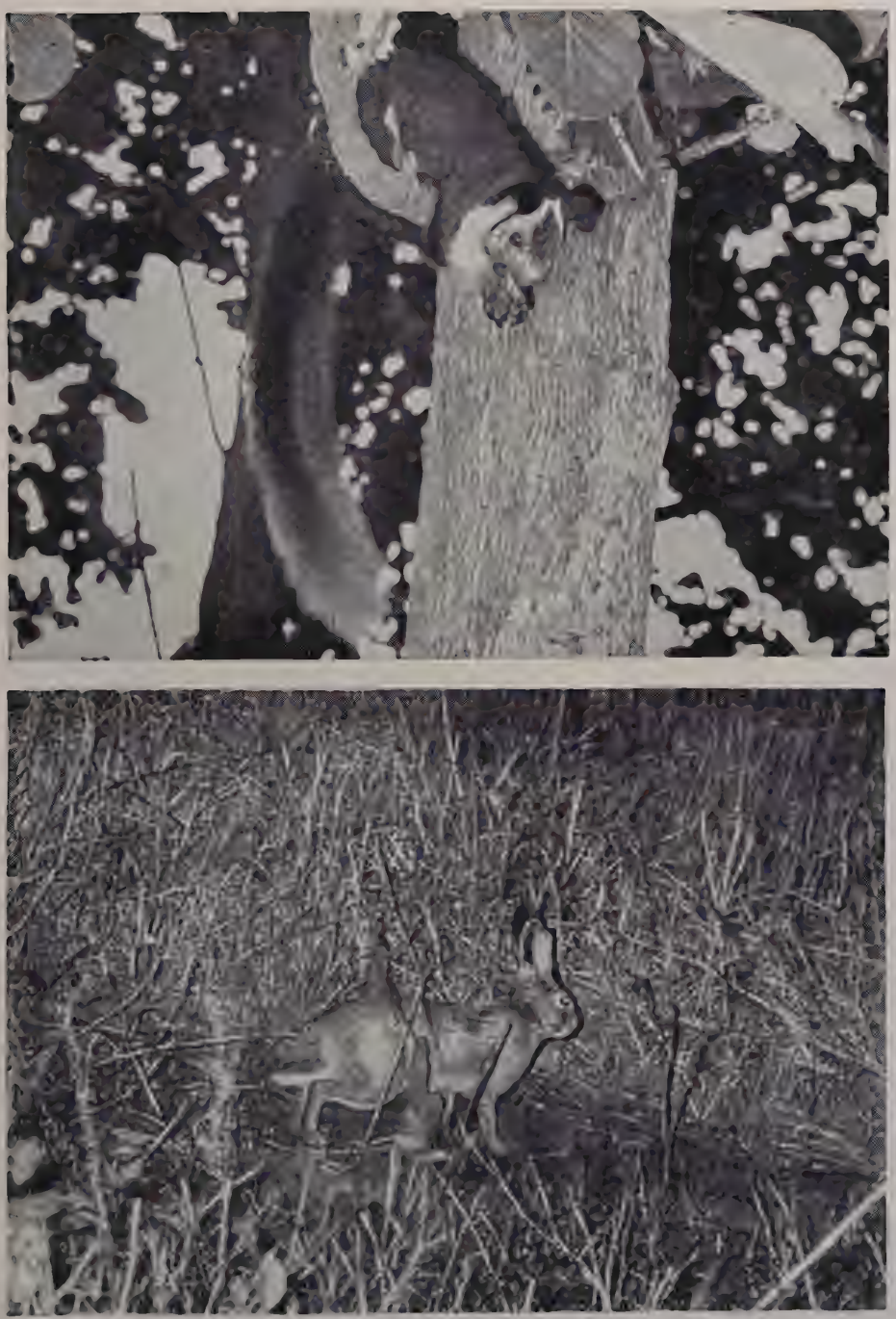
In the twenties, the decline of some wild animals was noticeable and noticed, and more stringent protective steps were taken, resulting, where the habitats of a threatened species were not exploited by men for forest produce, in an improvement in its status: the special protection accorded to the Nilgiri tahr by the Madras Government and the Nilgiri Game Association is an example of such successful conservation. There were failures, too.

The vital, intimate, delicate and complex interdependence of the fauna and the flora, however, was not appreciated, and only in a very few preserves were forestry operations not carried out, and even in them

village rights to exploit the forests were ceded. The natural forests were exploited for timber and other produce, clearfelled in coupes, and areas planted up with commercial indigenous species, and exotics like wattle, eucalyptus, casuarina, cashew and rubber. Private plantations, as of tea and coffee, were concurrently developed, and with the population increasing in and around the forests, the demands of the people on the forests for firewood, thatching grass, and other similar produce, and for grazing their cattle, also increased. Between the twenties and the present, the forests have been deeply and systematically invaded by men.

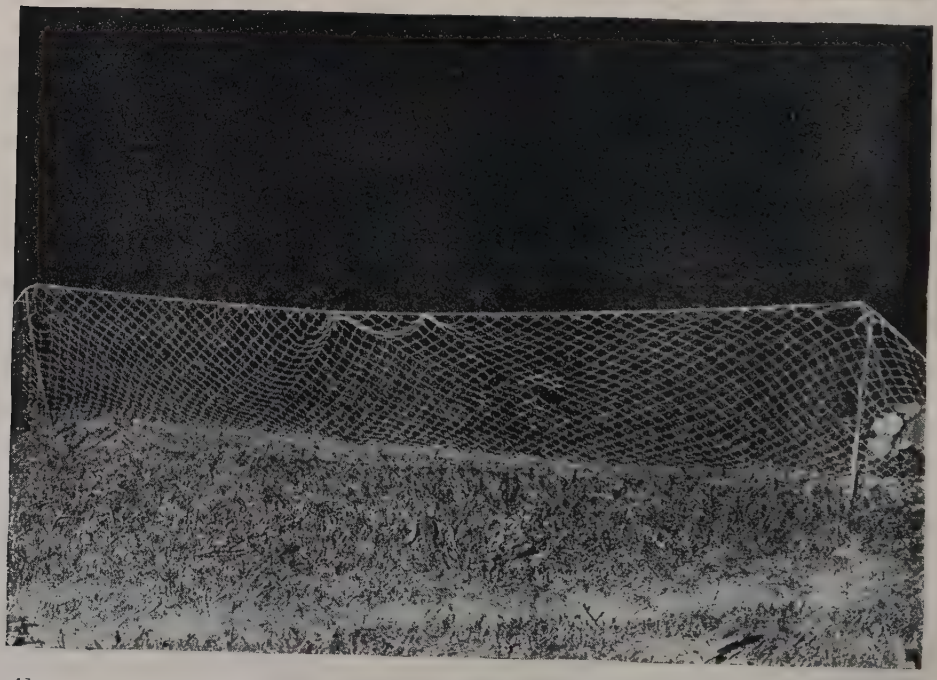
A century ago, Sanderson writing of the Mysore forests referred to thriving human settlements within the forests having been reclaimed by the jungle, and cited instances. Even today, the vestiges of such abandoned settlements survive in ruins in and around the forests he wrote of, such as Eeranamunti and Moolapura in the Bandipur Sanctuary, and Marasuranagudi in the Mudumalai Sanctuary. The position has been completely reversed today. There are few natural forests in the peninsula which have not been deeply penetrated by human enterprise, and apart from the forests having been denuded, or converted into plantations, or having degenerated, they have been occupied and are widely traversed by men. The repercussions on the wild animals of this intensive and deep penetration of their haunts by men, particularly its disturbance value, cannot be overestimated.

Before considering the causes for the decline of forests and wild animals in India briefly, a historical event that has profoundly affected the flora and fauna must be mentioned. After the Constitution of independent India came into force, the Central Government divested itself of such controlling authority as it had over what were, before the event, the provincial forests, and each State gained sovereign authority over its forests. No integrated, mandatory national policy governing the administration of India's forests has been possible, in consequence. Inevitably, in each State the political party in power has not hesitated, within the span of its unrestricted authority, to take steps which seem incapable of being retracted, with regard to its forests. There is little scope for a speculative analysis of motives, and none at all for polemics, in an ecological report, but it may be pointed out, relevantly, that some of these steps, such as the ceding of territorial rights within forests to private parties (as in Bihar and Tamil Nadu), the siting of major projects that affect the area for miles around in or near some of the best faunal areas in the country (as at Parambikulam, Moyar and Ramganga), the increased grant of collection and grazing rights to villagers around sanctuaries and reserved forests, the stepping up of departmental activities within the forests, and similar acts, all have a profoundly depletive influence on the flora and fauna. It is true that these same governments have also set up a number of new sanctuaries and otherwise have shown a conscious-



Above : TAMIL NADU 1969 : MUDUMALAI SA. : Kargudi : September 28 — p.m. : The semi-tame giant squirrel near the Range Office—TN. 53 ; *Below :* BIHAR 1969 : BETLA : PALAMAU : February 21 — Night : Hare — B. 14.

(*Photos : M. Krishnan*)



Above : M. P. 1969 : BORI : March 21 — midnight : Hare on the road-side — MP. 23 ;
Below : MAHARASHTRA 1968 : TAROBA N. P. : November 18 — about 8.15 p.m. : Net spread for poaching hares, near Jamni — MR. 3.

(*Photos : M. Krishnan*)

ness of their responsibilities by the wildlife of their area, but even today there is no recognition of the vital interdependence of the flora and the fauna, and no national wildlife policy that is enforceable, and even in the conferences of the national and State wildlife bodies, the term 'wildlife' is still used mainly to connote the larger wild mammals, or at times these along with the birds and a few other animals, and the flora is considered something quite distinct, a mere setting at best. Further, there is hardly any functional recognition at any level of the prime need for undisturbed living space for the flora and the fauna.

With the enormous growth of the human population and the growth of industries, and the vastly increased and more varied needs of the nation and the people today, the demands made on the forests, wastelands, marshes and other wildlife habitats have also increased and not only in a quantitative manner—these demands have also increased in variety and have a somewhat altered quiddity even when not new. It is no longer only a question of established forestry practices on a more intensive scale and of the forests being more heavily burdened with village rights. Industries and factories have to be supplied with raw materials (such as bamboo and pulp-wood for the paper and rayon industries) from the forests, land within the forests is found for agriculture, human settlements and resettlements (the Dandakarunya project is an example), factories (munitions factories, for example) and industries are located in and around the forests and also major hydroelectric and other projects. All this has naturally resulted in the forests being further opened up and deeper penetrated, cleared and disturbed.

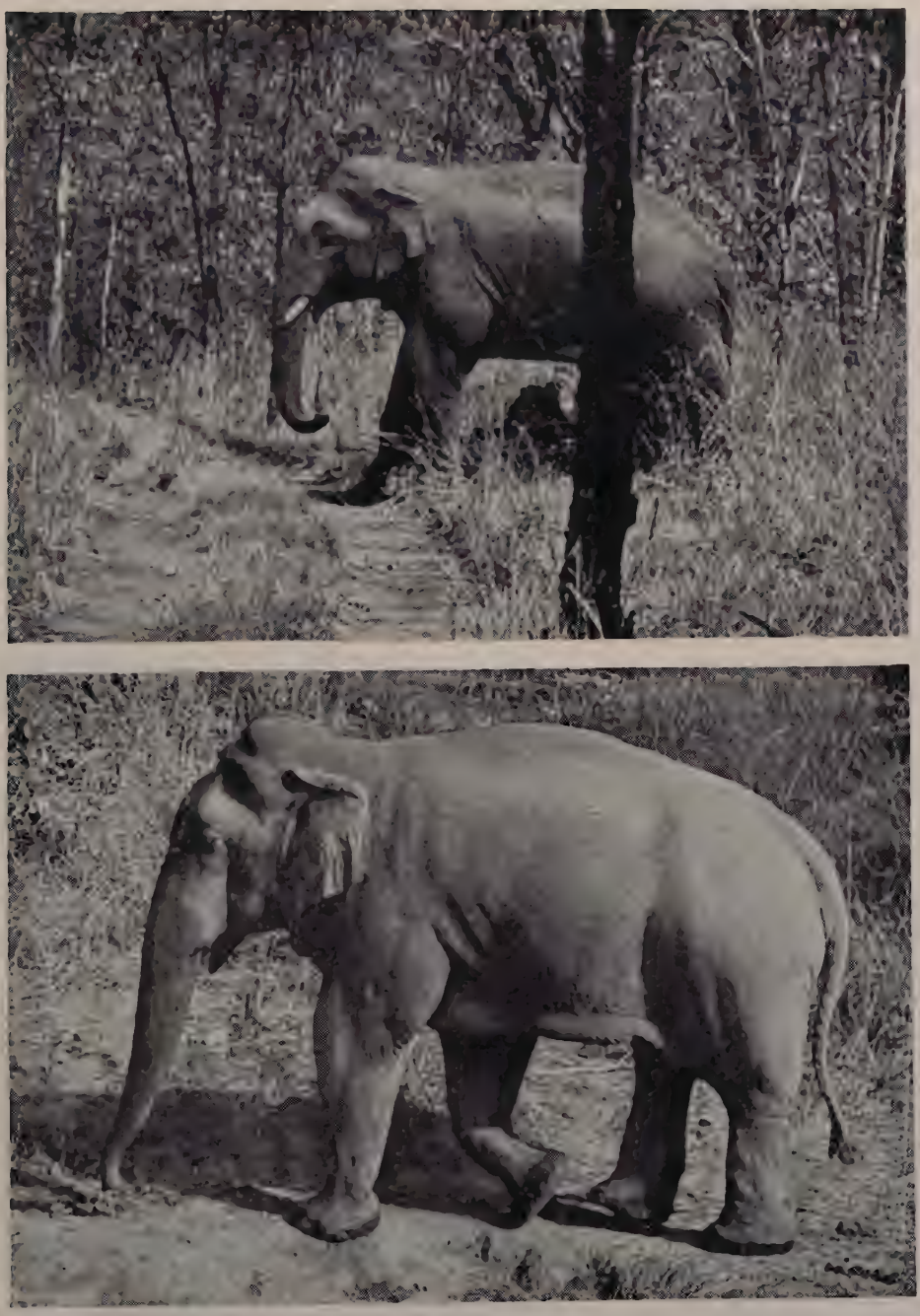
To the extent to which they disturb, alter and destroy the natural flora and environment of the wild animals and affect their interrelationships, these multifarious human demands on the forests are very much the concern of any ecological report, and for many years I have studied them in various parts of India, but it is unnecessary to enumerate and detail them here. For the purpose of this report it will be sufficient to briefly mention the main consequences of these human demands and activities.

The plains forests have disappeared entirely from many parts of south India and in places I have actually watched their disappearance. In the central and northern parts of the peninsula, there are plains forests left still, some of them dry, open jungles, but everywhere they have deteriorated by human exploitation. Even the hill-forests have been opened up, denuded in places, and deeply penetrated by human enterprise: in many areas they have degenerated. No figures to show the extent of this deterioration and denudation, or the increased extent to which human activities have entered the forests, are available in official records: all that official records can specify is the total forest area in each State (which, paradoxically, has remained the same for the past 50 years, except for

political readjustments and minor cedings of territory), the extent planted up with various species, the selection and clearfellings sanctioned, and similar details. I have, naturally, satisfied myself that the position is as stated by personal inquiry of various State Forest Departments, and the offices of the Inspector General of Forests and the Planning Commission, before making this statement. However, though unassessed statistically, all those with an informed interest in the forests of India know that there has been substantial deterioration and diminution of the natural forests by way of denudation, and degeneration caused by many influences (all related to human activities—some directly depletive, like wood-poaching) in the course of the past 50 years, especially the past 30, the probable extent of such deterioration being a matter of personal assessment and differing in different States. A recent depletive factor that may be mentioned in this connection is that in some States (Kerala, for example) there have been illegal encroachments by private parties, which have not been successfully resisted : in others, the tendency to cede rights within the forests to private individuals has been more marked in recent years. The extent of such, and similar, loss of forests is small compared to the total area, and negligible from the point of loss of revenue, but the effects of human occupation, which radiate far outward from small centres, have a powerful depletive influence on the wildlife.

Frequent disturbance by human activities has a most unsettling and unfortunate effect on the wild animals, although these activities are not directed towards them and are mainly concerned with the vegetation and terrain. Because of this, the animals may move out from favourable to unfavourable areas, and from protected haunts to areas where they are actively hunted—as one may observe on the outskirts of sanctuaries. When large enough and sufficiently upset by human interference with their normal activities, the wild animals may turn hostile to men, like elephants in places. It is necessary to point out again the multifaceted depletive potency of disturbance, as it is the least appreciated major factor in wildlife conservation in India.

The increasing growth of human settlements in and around the forests leads directly to an increase (whether officially sanctioned or not) of the exploitation of the forests (even in sanctuaries) by humanity for various reasons, such as the collection of fruits and mohwa flowers (B 68 Apr. 16, 70 Mar. 1), firewood (TN 63 Sep. 25—the General Account of the Hazaribagh N.P.), other forest produce such as thatching grass and bamboos, use for passing through from place to place, and cattle droving and grazing (practically ubiquitous, but reference may be made to TN 63 Sep. 25, 64 Apr. 13, 66 Oct. 7, 68 Dec. 11 and 16, 69 Sep. 22, 69 Dec. 12, 70 Sep. 15 and Oct. 3; K 70 Apr. 20 and AP 68 Nov. 6 to 13). Apart from cattle competing with the wild herbivores for fodder and water, the practice results from time to time in the communication of infections from



Above : BIHAR 1968 : BARESAND SA. : April 24 — a.m. : The bull with the broken tusks — B. 2 ; *Below :* BIHAR 1969 : BETLA : PALAMAU : February 19 — About 3.15 p.m. : The big cow, at Hathbajhwa — B. 12.

(*Photos : M. Krishnan*)

Above : BIHAR 1969 : BETLA : PALAMAU : February 23 — About 4.30 p.m. : The larger muckna going flat out, chasing the smaller. Note musth stain on cheek — B. 16 ; *Below :* BIHAR 1969 : BETLA : PALAMAU : February 26 — p.m. : Young calf staging a sit-down strike — B. 20.

(*Photos: M. Krishnan*)

cattle to the wild herbivores, such as rinderpest and foot-and-mouth disease with disastrous consequences (MY 68 Oct. 5—notes on gaur, sambar and chital).

Officially sanctioned collections of minor forest produce for departmental sale, are most deleterious in their impact on wild animals, and where the collections are intensified (as in Madhya Pradesh), naturally the harm they cause to wild animals is also intensified.

The spread of exotics into the natural forests is directly related to their opening up by human activities, and has in some areas resulted in serious ecological imbalance. Practically all exotics specially cultivated departmentally, such as casuarina, cashew, rubber and *Prosopis juliflora*, serve to deprive the wild animals of territory in long-held homes, but none of these is as inhibiting in this regard as the species of Australian wattle and eucalyptus assiduously cultivated departmentally. Curiously enough, some of the exotics accidentally introduced into the forests and countryside do not have an adverse effect on the wild animals. The most notable of these today is the lantana which, in places, offers congenial cover to the animals (TN 62 Sep. 12), though as fodder it is of much less importance—elephants, gaur and chital eat it desultorily when it is in fresh leaf. Iodine-rich *Eichhornia crassipes*, eaten in small quantities by some animals (MISC 68 Feb. 4) may, or may not, have some ultimate effect on those animals. Many plants of the Compositae have entered deep into the forests and appear to be only a hindrance to the wild mammals.

The harm from pollution, where factories are located close to faunal areas, and the lethal effects of insecticides on animal life, have been widely appreciated in the West, and it is possible this realisation might spread to India, too.

The main depletive factors have been mentioned. For two reasons, they have gained increased potency in recent times, first, because the increase in human population has led to greater human demands on wildlife habitats, second, because the decrease in the flora and fauna progressively limits the recuperative powers of the wildlife. For this second reason, I think that it is not the comparatively recently developed depletive factors that are currently most hostile to wild animals, but the oldest factor, going back to prehistoric times, hunting.

By hunting is meant, here, all modes of encompassing the death of wild animals, by licensed shooting, unlicensed shooting, snaring, netting, baiting, trapping, and organised hunting with bows and arrows, or spears, or both. Because the forests have been opened up and there are few inaccessibly remote retreats left for the wild animals, because the animals have less living space and are therefore easier located, and because protection (however justified the cause of its poverty) is poor, hunting has increasingly assumed a quite menacing depletive potency. No evidence

can be adduced in support of my view, but I have studied this problem for years and in many places, making inquiries of poachers, trappers, and many tribals, and I think professional meat-hunters, tribals indulging in regular orgies of hunting (MP 70 Mar. 27—photograph MP 40) and amateur poachers (many of them high-placed in status) are doing much greater damage to the wild animals today than is generally appreciated.

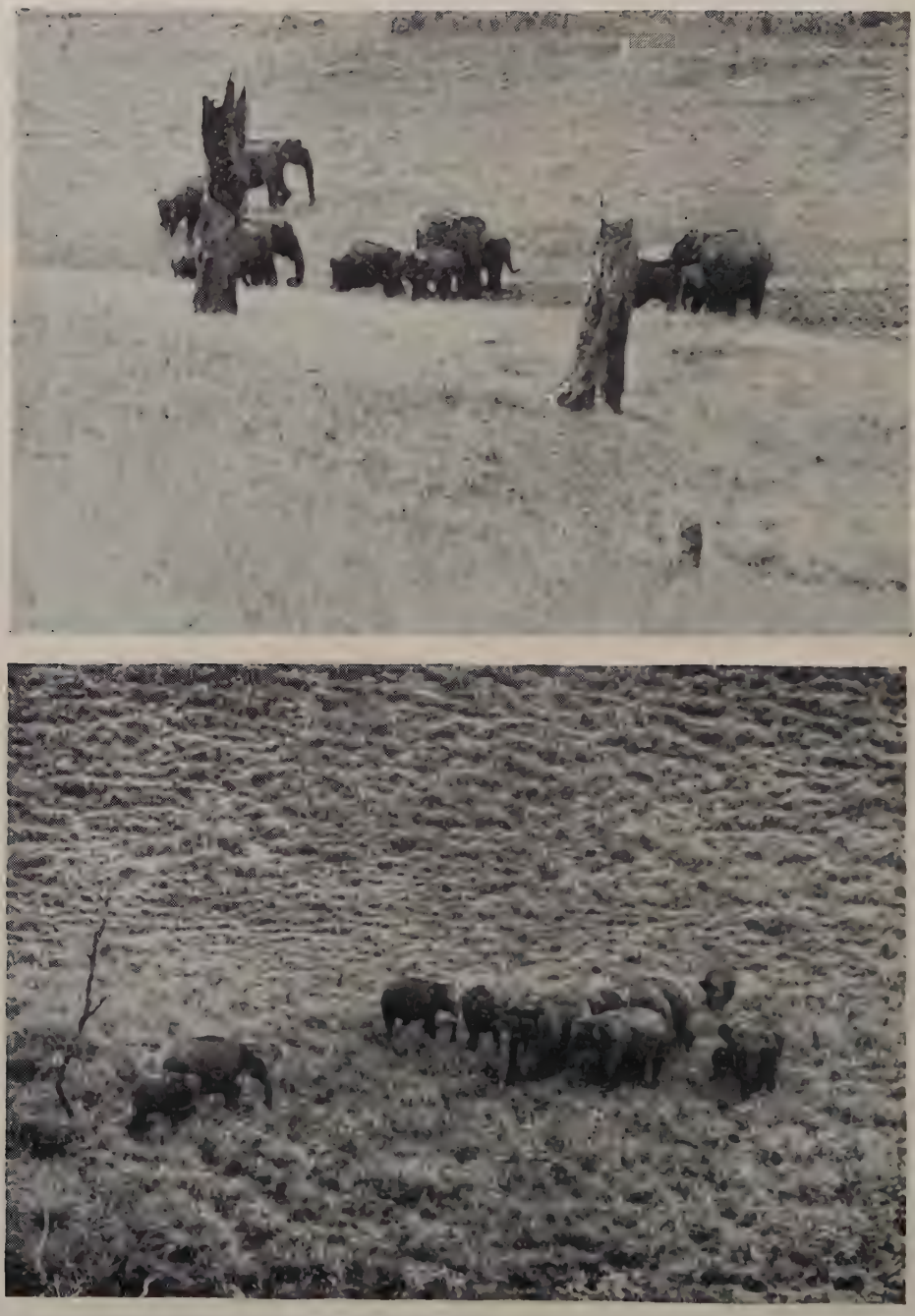
From inquiry made, the main cause for the notable decline of wild animals in areas formerly celebrated for their fauna (in Andhra Pradesh, Orissa and Madhya Pradesh, for example) seems to have been poaching by shikaris with guns and tribal hunting with less sophisticated but still lethal weapons and nets. Among tribals, hunting is mainly dependent on the traditions of each tribe; the tuber-eating Khadias of Orissa, for instance, do little hunting, while in the same State, Kols and Gonds indulge avidly in it. In general it may be said that tribals in the south of the peninsula are less given to hunting than those in the north, but no such regional bias governs poaching. It is practised everywhere.

The most obvious reaction of wild animals to sustained disturbance by humanity (and especially to hunting, which panics and unsettles them even when it does not succeed in killing them) is to convert them into shy, fugitive creatures of the night, and to cause them a greater degree of nervous tension than is normal in their lives. Animals which are normally abroad by day, like gaur, sambar and pig, retreat into cover with dawn and stay in hiding till near sunset: the difference between the behaviour of gaur in the Mudumalai and Bandipur Sas. and in Kanha N.P. is significant. Disturbance also leads to loss of the best feeding grounds and of safe waters (poachers usually sit up over the only available water within miles—MP 70 Mar. 27 and 31) and generally to a decline in animal populations.

Many animals have declined dangerously or become locally extinct within the past 20 years. Only the decline of one of them, the tiger, has excited popular interest here and abroad and been widely publicised. It is not as if the tiger became rare in India overnight: experienced men like Corbett predicted its decline over 20 years ago. When even the decline of the tiger, which has captured human imagination in India for some 2000 years, was noticed only at the last stage, it is only logical that the decline of less glamorous animals like the liontailed monkey, the sloth bear, the hyena, the wolf and the dinky little Indian fox has gone largely unnoticed, and even the local extinction of some of these, and the blackbuck and the leopard in some areas. In fact, all the mammals mentioned in this report (and a good few comparatively rarer mammals not mentioned here) have declined noticeably in numbers excepting the elephant, the chital and the pig: of these three, the seeming thriving status of the elephant is almost certainly illusory, as pointed out in the note on the

Above : BIHAR 1969 : BETLA : PALAMAU : February 26 — p.m. : Subadult elephants at play at the pool at Hathbajhwa — B. 21 ; *Below :* PERIYAR SA. : KERALA : May 20, 1959, a.m. : Tusker with tusks over 3-foot long — the presumed winner of the fight. Note raised weal above thigh — a tusk-wound — K. 2.

(*Photos : M. Krishnan*)



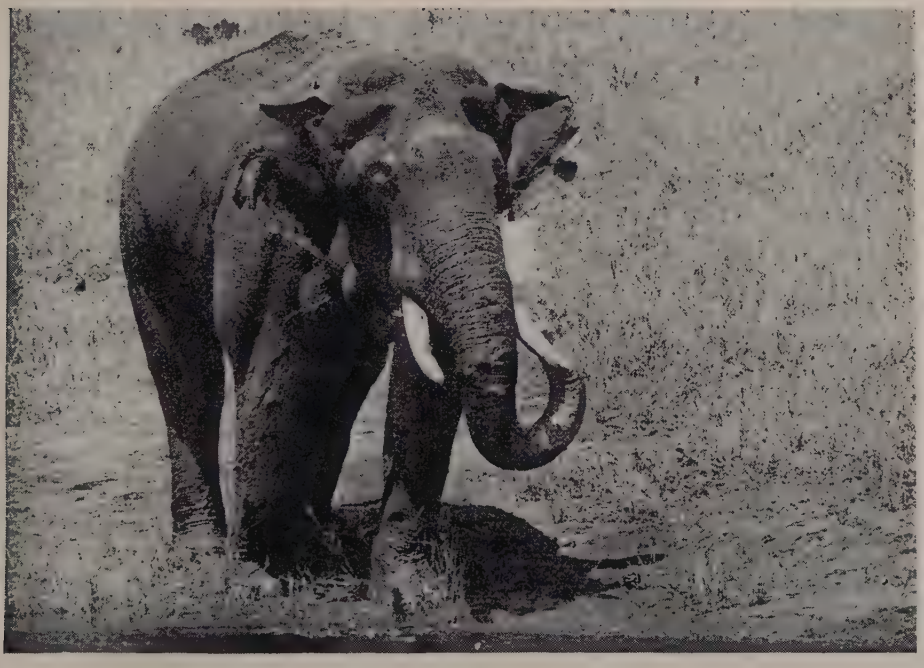
Above : KERALA 1969 : PERIYAR SA. : April 3 — p.m. : Herd of 12 elephants at an inland pool — K. 3 ; *Below :* KERALA 1960 : PERIYAR SA. : April 4 — a.m. : Herd of elephants grazing on a hill, near Koyyathotti — K. 4.

(*Photos : M. Krishnan*)

animal, and though it is protected today (and has been so protected for years) all over India, I predict that within a generation elephants, dispossessed of territory, are likely to be so much in men's way that in many areas they will be proscribed and destroyed.

This apathy to the dwindling of wildlife till the last stages of decline are reached is by no means peculiar to our country. In America and Europe, too, the people and the administrations awoke to the imperative need to preserve wildlife only after having lost much of it (more than we have), some species, like the American bison, by active hunting. Whether we will benefit from the experience of the West and save and revive what is left of our wildlife is a question to which no definite or succinct answer can be provided, and anyway the answer is clearly beyond the scope of this report. However, it may be said that in our national culture there is no scientific interest in nature. In our languages we do not have specific names for many plants and animals, and not even terms to distinguish the antelopes from the very different deer. Further, being preoccupied with national development and the many pressing consequences of overpopulation many people find it hard to appreciate the importance of something that offers no immediate, tangible benefit. Even in the West (where natural history had its origin and growth), it was only after the disillusionment and shattering of normal human values by war, that people came to realise that wildlife provides something much greater than recreation or aesthetic satisfaction, that it provides a fascinatingly varied, entirely natural and authentic, and vital interest in human life. Further, as pointed out already, we have the problem of national integration of the country's wildlife effort.

The next ten years are critical.



Above : KERALA 1960 : PERIYAR SA. : April 10 — a.m. : A perfect koomeriah. 9′ 10″ as per forefoot imprint : in musth — K. 5 ; *Below :* KERALA 1960 : PERIYAR SA. : April 10 — a.m. : Same lone tusker as in previous picture laving his swollen musth-glands. Note adherent clay on tusk and wounds on legs and trunk — K. 6.

(*Photos : M. Krishnan*)

Above : KERALA 1970 : PERIYAR SA. : April 20 — a.m. : The 'conference' breaking up — K. 9 ; *Below* : KERALA 1970 : PERIYAR SA. : April 22 — p.m. : Cow elephant dusting herself after a swim. Note lacing of pink to edge of ear in 2 cows — K. 10.

(*Photos : M. Krishnan*)

GENERAL ACCOUNT OF THE MAMMALS STUDIED

The order of arrangement follows the BOOK OF INDIAN ANIMALS by S. H. Prater (2nd edition, 1965) and the nomenclature, following that book, the CHECKLIST OF PALAEARCTIC AND INDIAN ANIMALS, 1758 to 1946, by Ellerman and Morrison-Scott (1951).

THE BONNET MONKEY

Macaca radiata (Geoffroy)

(Summary of field notes: Observation records: 22.

Locations: Forests 19: Mudumalai Sa., Ranganathittoo Sa., Bandipur, Point Calimere. Temple—3, Sholinghur.

Photographs: MISC 1, TN 47A, TN 60.)

This is much the commonest monkey of what used to be termed the Deccan, and south India, and commoner in and around rural and sub-urban areas (in scrub jungles, around villages and towns, and around certain shrines and railway stations) than in interior forests. However, the meagre record of it in the field notes exaggerates this comparative scarcity inside forests, and is partly due to my having ignored bonnet monkeys seen in tree forests, on occasion, in the preoccupation with some other animal. It is found in deciduous forests (MY 68 Oct. 6 & 18, 69 Oct. 9 and TN 70 Sep. 29) and I have seen it in the tall tree forests of Karwar and also in semi-evergreen forests, as in Courtallam. C. G. Webb-Peploe (*JBNHS*, Vol. 46—No. 4, p. 629 *et seq.*) reports its occurrence in the semi-evergreen forests of Naraikkadu in South Tirunelveli, along with the liontailed macaque. However, it is not a typical forest animal, and is rare or unknown in many montane forests.

Size : Morphological characters

As in other macaques, adult size is extremely variable. Prater gives the weight of a full-grown male at 13-19 lb. and of a female between 7 and 8 lb. The superior size of the male is more evident in macaques than in langurs, but in no troop of this monkey seen was a dominant male so much bulkier than the largest female that its weight could have been more than twice the female's ; further, even in animals of fair average size, the difference in weight between adult females is often greater than 1 lb.

Though the male is considerably larger than the female in adulthood, in this macaque variations in size independent of sex but based on locality and genetical factors can be even more pronounced. This difference in adult size between troops in different area does not seem to be dependent entirely on environment, but to be more complex.

It is not in dense forests, but in comparatively open country, in low-elevation hills and around shrines and human settlements, that the bonnet macaque attains its best development. The food advantages of such locations are obvious and probably the sustained intake, over generations, of more nourishing food than is available naturally in the forests has contributed to the physical superiority of this monkey where it is, in a large measure, dependent on humanity for its sustenance, but such a logical explanation does not account for the fact that where it is dependent on humanity, it is smaller in some areas than in others : for example, the size attained in Tirupathi, Papavinasam and Jalarpet is not reached at other shrines and railroad communities in the same region. Forest-living monkeys are generally smaller than those in rural and urban areas, and they seem to reach a larger size in the eastern regions of their range than in their western range.

What is specially interesting about this macaque is that even in the same area, it may display considerable variations in size from troop to troop. In the Mudumalai sanctuary of Tamil Nadu Wynaad, the bonnet monkey is mainly found in a few troops in the Theppakkadu-Kargudi areas, and is typically the smallish, rather furry forest-living kind. Typical specimens are shown in photograph TN 60. However, in the interior forests, a miniature bonnet monkey was noticed, hardly half the size of the commoner specimens around the human settlement at Theppakkadu, so fugitive in its response to humanity that it was not possible to observe it closely or for any length of time, and that only one clear picture of it could be taken (TN 59 Mar. 23, 1963 Sep. 28, 66 Sep. 27 and 69 Oct. 5). An adult female was seen carrying an infant only the size of a loris (TN 62 Mar. 25). The photograph (TN 47 A) shows the small size of 2 'miniature' bonnet macaques in relation to the fresh leaves on the culms of the giant bamboo.

Distribution

The distribution is limited to peninsular India well south of the Gangetic plain. Prater gives the northern limits of the bonnet macaque as up to Bombay on the west, and the Godavari on the east : it may be added that in the central part of this peninsular wedge, in the northern tracts of Andhra Pradesh, its range does not quite reach the river. Within the vast area of this peninsular wedge, its distribution is somewhat discontinuous : it is absent in some natural forests (and also in some rural areas). Although less likely to be deprived of territory by human occu-

Above : KERALA 1970 : PERIYAR SA. : April 22 — p.m. : Pregnant cow in musth (note black spot around pore of musth-gland — other pix of this cow show a similar spot on the left side, too) — K. 11 ; *Below :* KERALA 1970 : PERIYAR SA. : April 23 — a.m. : Elephants swimming across the Periyar. Note the landing, to the right, for which they are making — K. 13.

(*Photos : M. Krishnan*)

Above : KERALA 1970 : PERIYAR SA. : April 23 — a.m. : Elephants climbing ashore after the swim (see previous picture). Note border of pink to the ear of the central cow — K. 14 ; *Below :* KERALA 1970 : PERIYAR SA. : April 29 — a.m. : Elephants swimming across the Periyar — side view — K. 17.

(*Photos : M. Krishnan*)

pation of the plains forests than most other animals, since it adapts so readily to life around human settlements, it seems to have lost ground in places, but probably this loss has been compensated by the acquisition of new territory elsewhere. An interesting example of such conquest is provided by its introduction, by capture and release, into the coastal forests of Vedaranyam, near Point Calimere. In April 1965 some 30-odd monkeys, captured around Kumbakonam, were brought to the Kodikadu Reserved Forests and liberated : they are thriving in several troops now, with a total population of about 100, and have perhaps been helped in this by the absence of predators in the area.

Habits : Behaviour

A notable feature of the social organisation of the bonnet monkeys of various areas is that in natural forests they are usually to be found in small groups of from 3 or 4 to a dozen or so, and never in large numbers. They are shy of men in the forests, even fugitive, and spend much time in treetops. The big troops are to be seen in specially congenial areas where they are partly or mainly dependent on humanity for food, as around shrines and railway stations. In such places, a number of troops, probably composed of smaller units, live in loose associations where tolerance of one another within limits, and individual displays of threat and dominance, are observable in a complex, rather than in a pattern. It is noteworthy that with the change in feeding habits, from the industrious seeking for small titbits that is typical of life in the natural forests, to plunder and the quick picking up and thrusting into the cheek pouches of scattered human surplus food, they are much more terrestrial and swift-moving, and often gain noticeably in size and power. In the forest they spend much time in finding food, climbing trees to feed on leaf-buds and fruits, patiently combing the seeding heads of grasses with their lips to strip the seeds, hunting insects, or investigating plants growing in the interspaces between rocks for insubstantial fruits and buds ; even when food, such as the tender new leaf of the tamarind, is available in bulk, forestside bonnet macaques feed methodically, filling their cheek-pouches slowly and not stuffing them hurriedly. The vegetarian food includes the leaf-buds of the giant bamboo and the leaf-buds and foliage of many shrubs and trees, a variety of fruits including green fruits, and the seeds of grasses (TN 62 Mar. 13, 62 Sep. 13, 63 Sep. 13, 69 Dec. 12, 70 Sep. 29). Grubs, insects and other such small prey are also part of the diet, and birds' eggs when available. They eat the eggs rather clumsily. A group of 7 swam across the Kauveri where it was both deep and fast-flowing to a chain of islands on which water-birds were nesting in a packed colony, to raid the eggs from the nests ; incidentally, a crocodile was known to frequent the neighbourhood of these islands (MY 67 Aug. 14).

Many distinctive vocalisations, attitudes and gesticulations are used in communication, and expressions of dominance or submissivenes

threats and demonstrations. Among the main vocalisations may be mentioned the rattling, reverberating 'krrrrrr', well-known as the threat and anger call, and a soft short grunt, used in intraspecific communication when the monkeys are on the ground in company and moving through the undergrowth. A vocalisation I have heard on several occasions in the field, but never seen recorded in the literature available to me on this monkey, is a low, bird-like, cooing 'pio', reminiscent of the similar call used by the liontailed macaque. Prater, writing of the Assamese macaque (*Macaca assamensis*) mentions 'a rather plaintive musical call, a low "pio"': never having heard the Assamese macaque, I am unable to say whether this particular vocalisation of the bonnet macaque is similar, but the quotation from Prater would be a good description of this call as well. There is only one mention of the call in my field notes (TN 69 Dec. 12), but as said, I have heard it several times, and outside the period of this survey have also heard the similar call of the liontailed macaque in the wild.

A loud, sustained choking sound, difficult to describe in words except by a contradiction in terms, as a guttural screech, is used in intraspecific combats, and the same sound or a variant as the alarm call. Bonnet macaques come out with this call in frenzied repetition at the sight of a leopard or other predator, but are less unvarying in this than the langur. When up in trees and apparently when confident that they have not been seen, they may remain silent when a predator passes below them, hugging the bole and hiding in foliage.

When walking on the ground, without being excited or alarmed, the distal third of the long tail is trailed: naturally, other Indian macaques, which have short tails, never do this, but on occasion the Common Langur does so: however, the trailing of the tail along the ground in this manner is more usual with the macaque than with the langur.

Although highly arboreal, the bonnet macaque does not bound about the branches, or leap from treetop to treetop, in the manner of the Common Langur. However, in swarming up trees, sheer rock faces and walls, it is even more expert than the langur. At Courtallam, in April 1967, K. Krishnamoorthy showed me a vast, sheer rock-face up which he had seen a troop of some 30 bonnet macaques go swarming, clinging on to minute holds, an impressive performance.

This monkey is a good swimmer and, like the rhesus, takes to the water to get across from one bank of a pool to the other instead of taking the circuitous path around along the bank. It can enter the water very smoothly when it wants to, and swim submerged for short distances. Females carrying infants also take readily to the water, the young shifting from the abdomen to the shoulders to ride piggy-back and keep above the surface of the water (Photographs MISC 1 : notes MISC 60 May 24; MY 67 Aug. 14, 69 Oct. 9; TN 69 Dec. 12).

In biting their opponents (especially during intraspecific combats), the bonnet macaque, like all monkeys, seizes its adversary with both hands and pushes it at the moment of biting, thereby inflicting a quick, tearing wound that can be quite grievous (MISC 60 May 24).

Forest-living bonnet macaques favour the neighbourhood of large rivers and waterfalls.

There seems to be no defined breeding season in the wild and infants are seen both in summer and in September-October. An adult female with 2 infants is seen occasionally, but in such cases it is not known whether these are twins, or one is an adopted infant whose mother is no longer with it. The usual rule is one young at a birth.

THE RHESUS MONKEY

Macaca mulatta (Zimmermann)

(Summary of field notes : Observation records : 10.
Locations : West Bengal—Jaldapara Sa. : Orissa—around Balimela : Bihar—Palamau, Karkatnagar.
Photographs—B 32.)

The rhesus replaces the bonnet macaque as the commonest monkey of the country north of the Godavari. In places it is to be found in large numbers around shrines, railway stations and human settlements, but all records in the field notes are of forest-dwelling rhesus.

Size : Morphological characters

As in the bonnet macaque, size varies considerably with locality, and in adulthood the male is considerably larger than the female. It is easily distinguished from the bonnet monkey by the hair on the crown having a backward slant with no parting, instead of being arranged in a radiating 'bonnet', the shorter tail, and the more chunky build ; the burnt sienna to brownish orange colour of the pelage on the rump and lower back is distinctive—for the rest, the coat is an olive-grey, and the skin of the face and ears pink, as in the bonnet monkey. The two are of more or less the same size, and Prater gives the weight of the rhesus at from 10-14 lb. Within peninsular India, the rhesus also seems to attain its best physical development in areas where it is dependent on humanity for food. It is said to reach its maximum size in the sub-Himalayan region. Rhesus observed in Bihar were small-sized and almost olive-brown in colour (B 68 Apr. 22, 68 Apr. 25, 69 Feb. 20, 69 Mar. 2).

Forest-living rhesus are generally small, and in certain forests a few seem to decline to a miniature size, as in the bonnet macaque. In the Jaldapara sanctuary I saw a group of 4 such miniature rhesus (MISC. 65 Oct. 23).

Distribution

The rhesus has a wide distribution outside peninsular India, in the sub-Himalayan forests, Uttar Pradesh, West Bengal and Assam, and farther east into Burma and beyond. Prater gives the southern limits of its territory in peninsular India as the Tapti on the west and the Godavari on the east. In northern Andhra Pradesh it is to be found a little further south than the Godavari. In Orissa, Bihar and Madhya Pradesh the distribution of the rhesus is widely discontinuous. For example it is not to be found in the Hazaribagh and Kanha parks of Bihar and Madhya Pradesh. One probable explanation for this is that with the exception of the liontailed macaque and the Nilgiri langur, the macaques and langurs of peninsular India are all creatures of the deciduous forests and do not occur in evergreen tracts. For this reason the rhesus will not be found where sal dominates the flora. It is true that neither in Hazaribagh nor in Kanha does sal occur in dense continuous belts, as it does in the Simlipal hills of Orissa; I have not seen the rhesus in the Simlipal hills either, but my acquaintance with their sal forests is limited to 7 days spread over 3 years.

Habits : Behaviour

Although it climbs trees and rocky escarpments expertly, the rhesus is much more terrestrial than the bonnet macaque, especially when feeding. It takes readily to water and is a powerful swimmer. A troop of 19 was observed in the Palamau N.P. (Bihar), clinging on to the low steep banks of a pool, using one hand to fish out an alga from the water, and eating it (B 70 Feb. 22; photograph B 32). Forest-living rhesus spend much of their day searching for food assiduously, eating leaves, buds and insects, and similar insubstantial morsels. In their feeding habits they are similar to bonnet macaques, but noticeably less arboreal.

In their vocalisations, too, they are somewhat similar, though except when screeching and grunting during intraspecific fights and disputes (bonnet monkeys also indulge in this while fighting) they seem to be less vocal. They do not have the low, musical 'pio' call, used by bonnet monkeys in treetops. Breeding is not limited to a defined season.

THE LIONTAILED MONKEY

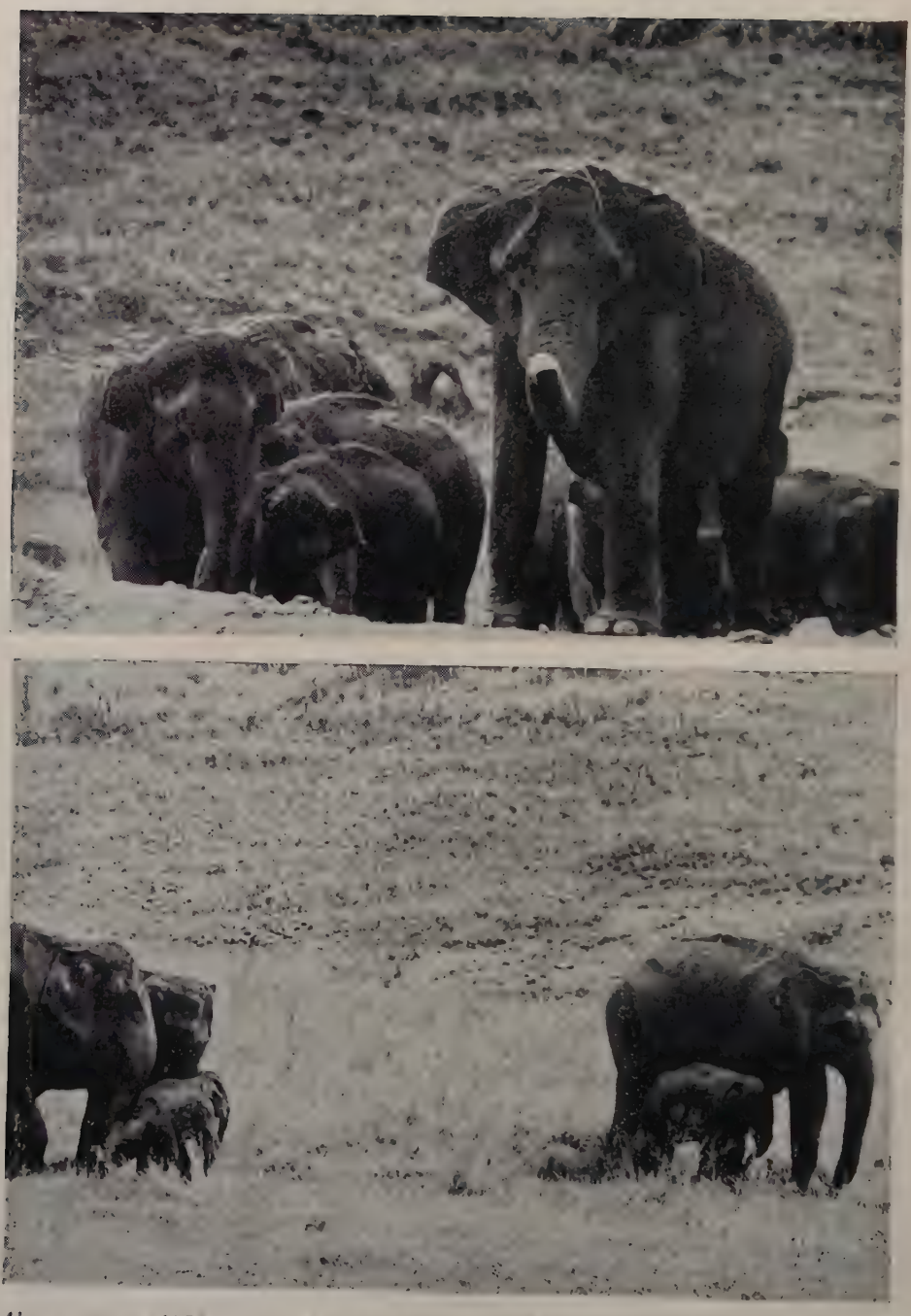
Macaca silenus (Linnaeus)

(Summary of field notes: Observation record : 1
Location: Varagaliyar, Anamalais.
No photographs.)

The liontailed macaque has the most restricted distribution of all Indian monkeys, being confined to a few evergreen forests of the Western

Above : KERALA 1970 : PERIYAR SA. : April 29 — a.m. : The same party shown swimming in the previous picture climbing ashore. Note gradual slope of landing — K. 18 ; *Below :* KERALA 1970 : PERIYAR SA. : April 30 — a.m. : Cow scraping and eating salt-earth — note the encumbering calf — K. 21.

(*Photos : M. Krishnan*)



Above : KERALA 1970 : PERIYAR SA. : May 1 — a.m. : Cow smelling me — the elephants following her left the path and went away — K. 22 ; *Below :* KERALA 1970 : PERIYAR SA. : MAY 1 — a.m. : A calf, lying down in its mother's path, being hoisted to its legs — K. 23.

(*Photos : M. Krishnan*)

Ghats in Tamil Nadu and Kerala. It has been much depleted over the past 50 years by systematic poaching for the sake of the pelage and flesh of the adult, and the capture of the young for sale as live specimens. In hunting this monkey and capturing the young, slings and bows are usually used; the mother is killed or wounded so severely as to be incapable of flight, and the infant then captured.

Some 35 years ago I have seen it, and observed it closely, in the evergreen forests of the Thirunelveli district around Courtallam : it is no longer to be found in this location, or in some other locations where it was known then. Its current status is adequately described by the word ' precarious '.

Size : Morphological characters

The size of this forest-living monkey is approximately that of the other two macaques of the peninsular area, the bonnet macaque and the rhesus, but is even more variable among adult individuals; the superior size of the male in adulthood is noticeable in this species also. The build, especially in adults, is more thickset than in the other macaques.

The sleek black coat and the luxuriant ruff of long, warm grey hair around the black face, forming almost a mane, are the distinctive features of this monkey; the short tail is not leonine, ending only in an inconspicuous tuft.

The only other black monkey of India (excluding the only ape of the country), the Nilgiri langur, is also usually found in evergreen forests inhabited by the liontailed macaque. Both are arboreal, and the langur also has a warm grey ruff, more brownish grey and less luxuriant, but these details are hard to distinguish in the treetops, as also the more reachy build of the langur. The much shorter tail of the macaque, and its quieter movements, serve to distinguish it from the langur.

Distribution

Prater gives the distribution as the Western Ghats from North Kanara southwards to Kerala. It seems to have died out in its northern range and to be now limited to its southern reaches, as already said. It is essentially a seclusive monkey of the deeper evergreen forests.

Habits : Behaviour

The liontailed macaque is found well away from human settlements, in small parties of from half-a-dozen to a dozen or more. It feeds both in treetops and on the ground, and is similar in its feeding habits to the bonnet macaque. It is more deliberate in its movements and notably less vocal. The only sounds heard in the wild were a rather bird-like intraspecific call (also heard in the Calcutta and Madras Zoological gardens), louder than the musical 'pio' of arboreal bonnet macaques but similar to it (MISC 60 Apr. 30), and a soft grunt. I have heard these

calls on several occasions, long prior to the period of the present survey, in the wild : they can also be heard where a number of these monkeys are housed together in a zoo. Webb-Peploe (*JBNHS* **46** : 4, 629 *et seq.*) reported that in the evergreen forests of Naraikkadu, South Thirunelveli, these monkeys were seen in a troop of about 20, that they were shy of men and deliberate in their movements, and descended from one tree to climb another instead of proceeding along the tree-tops, and that they were feared by the langurs (presumably the Nilgiri langur) and bonnet monkeys ; he records two calls, a subdued grunt and a loud, pigeon-like 'coo'. Prater (whose book is mainly a compilation), presumably following Webb-Peploe in part, gives this account of vocalisations: 'The call of the male is said to resemble the human voice. It is compared to the "coyeh" of a man trying to get in touch with his lost companions in the jungle, and again to the loud "coo" of a pigeon.' It seems extremely unlikely that a highly gregarious animal like this macaque should have occasion for a penetrating 'coyeh' as of a man calling to lost companions, and I have never heard this call, but in view of the narrow limitation of my personal knowledge of this monkey, made diligent inquiry of tribals in the Anamalais, and the Periyar area of Kerala, who knew it in the wild much better, being those who poached it for pecuniary gain, and they, too, said they had never heard the call, but only the bird-like 'pio'—in fact they locate their quarry when hunting it mainly by this call. As to this call being like the loud 'coo' of a pigeon, the question is which particular pigeon's 'coo' it resembles : if it is the polysyllabic modulated call of a green pigeon of the genus *Treron*, the further qualification may be added that the macaque's call is also modulated and less polysyllabic, being like a phrase of the bird's call rather than the entire call.

THE COMMON LANGUR

Presbytis entellus (Dufresne)

(Summary of field notes : Observation records : 76.

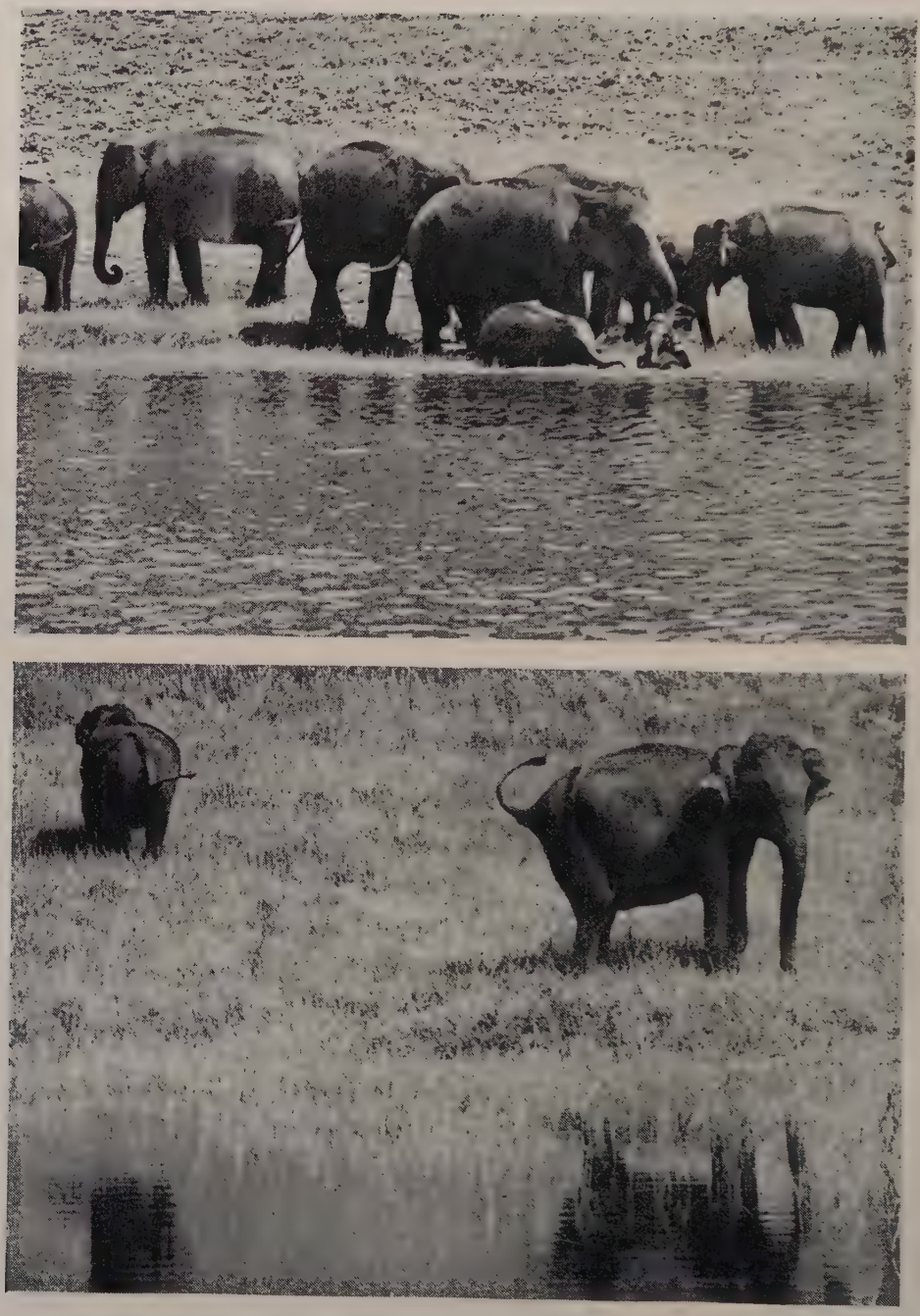
Locations : Tamil Nadu—Mudumalai Sa. ; Mysore—Bandipur ; Orissa—Balimela, Raigoda Sa. ; Bihar—Palamau N.P.; Madhya Pradesh—Kanha N.P. ; Churna ; Maharashtra—Taroba N.P. ; Uttar Pradesh—along the Sharada canal.

Photographs—TN 17, 43 ; MP 8, 33 ; MR 1, 2, 4, 15.)

The grey langur (Common Langur) is the only Indian monkey with a distribution all over India, from the Himalayas to Kanyakumari. Taxonomists have recognized a dozen territorial races within the peninsula, based, among other considerations, on the colour of the hands and feet. Summing up these distinctions, Prater says that the contrast between the white ruff around the face and the darker hair of the body, vivid

Above : KERALA 1970 : PERIYAR SA. : May 1 — a.m. : Calf in previous picture waiting for its mother after a spell of play with another calf — K. 24 ; *Below :* KERALA 1970 : PERIYAR SA. : May 1 — a.m. : A big cow suckling her calf — K. 25.

(*Photos : M. Krishnan*)



Above : KERALA 1970 : PERIYAR SA. : May 2 — a.m. : Calves playing in the water — K. 26 ; *Below :* KERALA 1970 : PERIYAR SA. : May 3 — a.m. : Typical attitude of a cow panicking — K. 27.

(*Photos : M. Krishnan*)

in Himalayan specimens, is less apparent in peninsular animals, but that 'among them there is variation in the colouring of the hands and feet' which, 'are almost black in langurs from the plains of northern India, become paler as one travels southwards to the Deccan, and are almost white in the dry zone of south-east India'. Perhaps this entire question of races is due for a revision by competent taxonomists. A search for one of the white-handed races described in Blanford's fauna, in the locality of his type-specimens, proved infructuous, the langur seen being black-handed. Further, the darkest grey I have seen in the pelage of this monkey was a langur seen along the Sharada canal in Uttar Pradesh (MISC 68 May 21).

Size : Morphological characters

This langur attains its maximum size and richness of pelage in the Himalayan region. Prater gives the weight of peninsular animals as from 20 to 35 lb.

The grey langur is much taller and heavier than any of the macaques of the peninsula, with the comparatively slim, long-limbed build of its tribe, and a long tail ending in a white-haired tuft, usually in a conspicuous tuft. The difference in size between the adult male and female is much less obvious than in macaques, and size variations among adults in a troop are also less flagrant.

The question of size in comparison to other species of the genus is interesting, the race occurring in or around each of these other species being taken into account. The grey langur is relatively larger than the golden langur (MISC 68 February 15) and perhaps longer than the Nilgiri langur, but slimmer built.

The basal third of the tail is muscular, and the tail is often carried gaily, though the distal half of it is lax and pendent. In adulthood the tail is not prehensile, but in infancy it is, and the infant being carried clinging to the abdomen of its mother loops its tail around the base of its mother's for an additional hold when being carried at a run (MR 68 November 18). The infant langur is black or a very dark grey at birth, but the hair on its coat turns to a pale grey in the first month of its life : apparently the transition is swift, for though I have looked for it, I have not seen young animals in an intermediate stage of this change of colour (TN 59 April 3, 66 April 2, 5, 6 ; MP 69 March 9, 21, 70 March 15, 20). In the bonnet macaque, too, the newborn young is dusky or black. Has this dark colour of the infant changing abruptly to pale grey any phylogenetic significance or is it purely an ontogenetic change? (Photograph MP 33).

The grey langur is typically the monkey of deciduous forests and the total number of observation records of it, exceeding twice the sum total of such records of all three macaques mentioned, in the field notes, is a true reflection of its commoner occurrence in the forests, for it was ignored even oftener than those macaques.

Prater, following faunas, mentions that it is to be found throughout India 'except the western deserts'. This statement needs amplification and addition. Not only is the langur not found in desert regions, but it is also absent from the indeterminate peripheral scrub that has become such a feature of human occupation of the plains forests in India over the past three decades, being essentially a forest monkey.

A further factor conditioning its distribution, also caused by human agency, is that in places it has been killed out, or so harried by men that it has left the area. Tribals hunt the grey langur for its flesh, and its flesh is also in demand for the sake of the therapeutic potency attributed to it superstitiously. In Sholinghur, where this langur was common, it was wiped out by hunting within half-a-dozen years (MISC 60 May 24).

A purely natural factor, also limiting the distribution of the grey langur, is that it is essentially an inhabitant of deciduous forests (including dry deciduous forests, like Betla in Bihar) and does not enter true evergreen forests. In northern peninsular India, where sal is practically the only evergreen species of ecological importance, such forests occur in sizeable belts rather than in patches, and there is no monkey peculiar to the evergreen tracts. In areas where sal occurs in patches, as in the Kanha N.P., the grey langur is common in the areas around, but not in the Hazaribagh park.

South of the sal areas of the peninsula, the floristic ecology is quite different. A great number of evergreen tree species, not totally unmixed with deciduous species (in fact, in places sal grows so gregariously that the deciduous 'sal associates' are much less common than in southern evergreen forests), form patches and belts of evergreen and semi-evergreen forests, some of them of comparatively low stature and at comparatively low elevations, dependent largely on rainfall and edaphic factors—we have sholas and patches of evergreen forest. The grey langur is not found in them, though the Nilgiri langur is quite frequently. A fuller account of this interesting question of floristic ecology determining distribution is provided in the note on the Nilgiri langur, but it may be said here that in peninsular India today all the man-imposed and natural factors mentioned serve to render the distribution of the grey langur highly discontinuous.

Habits : Behaviour

Like all Indian monkeys, the langur is gregarious. In the forest areas selected for this survey, it was seen in parties of from 4 to 18. On occasion, large troops of from 18 to 36 were seen feeding together in the treetops on the sprouting leaf-buds or on fruits, or feeding on the ground, but these were obviously composite troops of 2 or more parties, and split into parties in their getaway on being approached (TN 66 April 9, 69 October 4 ; MY 68 October 24 ; MR 68 November 29). At other times,

Above : KERALA 1970 : PERIYAR SA. : May 6 — a.m. : Lone tusker at Aruvi dusting grass against his knee — K. 29 . *Below* : KERALA 1970 : PERIYAR SA. : May 6 — p.m. : The lone tusker on the island. He was not rubbing himself against the deadwood, but turning sharply past to get near the boat — K. 30.

(*Photos : M. Krishnan*)

Above : KERALA 1970 : PERIYAR SA. : May 8 — a.m. : Lone tusker feeding on submerged grass and sedge — K. 35 ; *Below :* KERALA 1970 : PERIYAR SA. : May 9 — a.m. : Herd of 16 elephants in the bay behind the rest-house — K. 36.

(*Photos : M. Krishnan*)

a single langur, or 2 or 3 together, were seen, but presumably there were other langur not far away (TN 62 April 4 ; O 69 January 14 & 21).

Three separate parties of langur more or less resident in Lower Kargudi (Mudumalai Sanctuary) were noticed from time to time during April 1966 ; these kept apart and did not mingle, though at times they were very close to one another—it was possible to identify these parties easily by the difference in age between the young in them, and by one containing 2 adult males, another 1, and the third none (the field notes provided here do not contain a detailed record : TN 66 April 2, 3 & 6). A party of 15 observed in the Taroba N.P. in November 1968 was still together a year later, though increased to 19 by new births (MR 68 November 18 & 69 November 26).

In parties with a more or less fixed composition, no defined pattern of dominance by one adult male was evident unvaryingly. A party of 9 observed consisted of an adult dominant male, 5 adult females two of which had months' old grey young with them, and another adult male which was of the party but not in it, keeping to the periphery and avoiding the proximity of the dominant male ; this second male was restive and aggressive, and made several threatening advances towards the groups of females and young. The dominant male ignored him, not even indulging in a threat gesture, but on one occasion when this 'rogue male' threatened one of them, 4 adult females joined together and chased him away (TN 66 April 2 & 12 : Photograph TN 43). In another party of 11, the dominant male, a big langur with a kinked tail, was relaxed in the fork of a teak, while up another teak a pair of young adults sat very close, a male hugging a female, using both hands and a leg to hold her ; for over an hour he just sat there hugging the female, with no overt sign of sexual desire, hardly moving (TN 62 March 30).

The young langur stays close to its mother even after it is half-grown, and even when well able to run and climb, rushes to its mother at the least alarm and is carried by her, clinging to her abdomen. Mother langur suckle their young for quite a long time—one infant was suckled for nearly 11 minutes (MR 68 November 18 : Photograph MR 2). When they do not want their young to stray from their side, females restrain their young by holding on to their tails, just above the tip : I have seen a mother langur drinking at a puddle, while holding the tip of her progeny's tail in one hand. Bonnet macaques, which also have long tails, use the same hold to restrain their young.

The normal walk is leisurely and easy, and at times langur even creep silently through the undershrub. But when bolting in alarm, their bounding run has a somewhat laboured and exaggerated action, with the palms, and the soles of the feet, slapping the ground audibly. They are very much at home in trees and can move along branches and climb smoothly, but when scaling a steep rock or going up the bole of a tree,

usually go up in a few bounds, and often bound along the boughs with sure-footed, energetic speed, shaking the foliage and twigs with the exuberance of their progress. No doubt their size and weight account for this in part, but for the rest it is the exuberance of their movements.

Their acrobatic leaps from treetop to treetop have been commented upon by every observer. To gain momentum for the leap, they run along the bough with a down-pressing action, so that the upward lash of the branch at the moment of taking off adds propulsion to their leap. Many observers have commented on the predisposition of the grey langur (and other monkeys) to leave the safety of the treetops and descend to the ground, where it can be overtaken, when pursued by an enemy. This might be due to the desire for concealment as an escape. This langur will, when closely watched, draw the foliage of the tree it is sitting on around itself, to hide its face, an action that seems peculiar to it. Langur sitting in a tree bare of foliage will leave it at once when approached by a man, whereas where the tree has a leafy crown, they may stay on (TN 66 April 9).

The thick, calloused skin on the palms and the soles, and the sitting pads beneath the tail, enable langur to climb trees and run on the ground energetically, as well as to sprawl at ease in repose. The attitudes assumed by them during their midday siesta in treetops are often extremely relaxed, and both on the ground and up a tree a favourite rest-position is to sit on the subcaudal pads, with the tail hanging limp or stretched on the ground behind, with both hind legs stretched out in front and elevated, resting on some support (such as a branch or a stump) at the level of the shoulder, with the arms resting on the legs (TN 62 March 30; MR 68 November 27).

Their roosting behaviour is interesting. A suitable tall tree is selected, probably one already used many times, in the vicinity of where they have been feeding in the evening, and towards sunset the langur repair to it singly and in twos and threes, and climb up to a stout, leafy lateral branch on high. There is much vigorous agitation of the boughs during this ascent to roost, but not many noisy wranglings—the agitation of the branches is, presumably, a territorial staking of claim, but it does serve to dislodge debris and dead leaves and twigs from the tree, and possibly unwelcome earlier occupants, though it is a purely instinctive action. All the langur have ascended by nightfall and thereafter they roost in tight company, in one or two groups, on the selected branch or branches. They are so completely hidden by foliage that only their pendent tails, hanging like clustered aerial roots, are visible from below. A tall mango, and a *Lagerstroemia lanceolata* in thick leaf were the trees selected in the instances observed, and if a tall tree in leaf is available, it is chosen (TN 64 March 30; MR 68 November 25, 26; 69 November 19, 20, 26). Prater mentions that a troop returns to the same roosting tree night after night; this has not been my experience.

Above : KERALA 1970 : PERIYAR SA. : May 9 — a.m. : Herd of 20 elephants in a bay : Cow having a wallow — K. 37 ; *Below :* KERALA 1970 : PERIYAR SA. : May 9 — a.m. : Herd of 20 elephants in a bay. Young tusker rubbing himself against tree. Note turgid, outwardly-directed breast of cow — K. 38.

(*Photos : M. Krishnan*)

Above : KERALA 1970 : PERIYAR SA. : May 9 — a.m. : Herd of 20 elephants in a bay. Grown cow crossing the log — K. 39 ; *Below :* KERALA 1970 : PERIYAR SA. : May 9 — a.m. : Herd of 20 elephants in a bay. Calf attempting to get over the log : Note cow leading young round obstacle — K. 40.

(*Photos : M. Krishnan*)

In the Taroba N.P. I noticed that an iora had built its nest in the mango tree in which the langur roosted, and a number of roseringed parakeets were also roosting in the top branches, and they seemed in no way affected by the violent shaking to which the langur subjected the tree. Langur seem to be late risers and the roosting party watched in Taroba did not descend till 7 a.m. : prior to descent, too, the tree is shaken.

When it rains langur seek the shelter of trees with leafy crowns, especially when there are young in the party. During sustained downpours, when the drip from the leaves is heavy, they continue to stay in treetops, in huddled immobile groups, some of them little protected by the canopy, with the rainwater cascading from their pendent tails. When the rains stops, they shake themselves like wet dogs, and bound about the larger branches not too energetically to dry themselves—considering that the wet surfaces of these branches are prone to be slippery, this restraint on their exuberance is understandable (TN 66 April 11 & 18).

The violent shaking of boughs and foliage, and the display of teeth in a silent snarl, are the main intimidatory gestures. The tail is highly expressive in repose and action. While sitting in a tree in repose, it hangs straight down, at times loosely draped around a branch below, and while resting on the forest floor is laid full length along the ground. Moving at leisure on the ground, it is often trailed, and when walking faster or running, is elevated, with the distal half pendent in a bold loop or flowing behind, depending on the pace of the animal: when about to take a leap, the tail is often raised high and flung so far forward that the tip is above the head of the monkey (Photographs: MP 8; MR 1).

The two main vocalisations, the normal, loud, joyous-sounding whoops and the repeated, frenzied swearing at the sight of a predator, have been described by many observers. Regarding the latter, it may be said that it seems to be a compulsive instinctive response to the sight of danger or suspected danger, and also an expression of aggressive intent; as remarked by all observers, it is sustained only so long as the object of alarm or hatred is in sight. It is indulged in from a treetop or similar elevated stance—langur on the ground run away in silence when a predator approaches, and it is significant that on such occasions their run is much less exuberant than usual, more of a hasty sneaking away than a bounding along, and that the ground is not slapped sharply by the palms and soles. In spite of its keen daytime vision (the main perceptive faculty of the monkey) it swears not only at a live predator but also at the carcass of a leopard or tiger being carried through the forest, and also at any object reminiscent of the pelage of the dreaded predators, the swearing being an instinctive, and not a reasoned response. Years ago, while proceeding in an open jeep along a forest road in Ramgad in Sandur, our passage was marked by the vociferous swearing of every group of langur up trees we passed, which swore hysterically at my wife, who was

wearing a saree with a chrome yellow ground patterned with black in a somewhat pantherine pattern! Bonnet monkeys seem more discriminate in swearing at predators.

During such vocal demonstrations, langur violently agitate the treetops they are in. Both the frenzied swearing and the agitation of boughs and foliage is freely indulged in during aggressive displays between adult males (MY 68 Oct. 7, 13 & 18).

Subadults indulging in rough-and-tumbles screech and squeal. A fear-call oftener heard from very young langur than from adults is a low, tremulous whimper.

Grooming activity is similar to that of other monkeys. A display of affection by hugging the object of affection is also noticeable in this monkey, as already detailed, and is probably a common feature of the behaviour of all primates.

Like other langurs, it is a strict vegetarian in its diet. Twice, grey langur were observed snatching at swarming termites issuing from the earth after early summer rains (TN 62 March 15, 66 April 18). These were probably aberrant specimens, and if they were not, their haphazard, fumbling attempts at catching the winged insect in the air seemed good evidence of their vegetarianism.

The most notable thing about their feeding habits is that unlike other Indian monkeys, their gregariousness while feeding is not almost exclusively intraspecific. At times rhesus and bonnet macaques may unwillingly share pickings with other animals, as with dogs at railway stations; they are then scavenging in competition with other animals rather than feeding in company with them, and it is not mutual tolerance but a fear of each other that sustains the uneasy truce between them, and even so in the heat of competition for scraps there are frequent quarrels. In other forest-living monkeys, 2 or more different parties do not feed together; the dominant party drives away the literally more recessive one. But grey langur, in an entirely unforced forest setting, frequently feed amicably in a large composite troop of several parties, both in treetops and on the ground (TN 66 April 9, 69 October 4; MY 68 October 24; MR 68 Nov. 29). At such times, and when a group is feeding by itself also, an adult (especially a dominant male) will threaten an actual intruder on its feeding, and a dominant animal may occasionally usurp the feeding site occupied by a subordinate, but langur feeding in company are remarkably quiet and peaceable compared to macaques. Further, besides feeding amicably along with their own kind, grey langur feed in company with rhesus and bonnet monkeys, and with chital too, on the ground—up trees, they are not seen in company with other monkeys. Both in the Mudumalai Sanctuary and in Kanha N.P. I have seen langur feeding on the forest floor along with chital, but only one instance has been noted down (MP 70 March 20): on that occasion, the mothers of 2 black in-

fants, usually so anxious for the safety of their progeny, were quite unconcerned as the infants pranced about on unsteady limbs among the chital hinds sharing the parched gram at Sravantal lick with the monkeys.

Langur feed on a wide variety of vegetarian fare, leaf-buds and leaves, flowers, fruits and seeds, and twigs : I am told they also eat some (unspecified) roots or stolons, and bulbs, and although I have no proof I strongly suspect them of feeding on edible mushrooms and puffballs. In summer, when the deciduous trees are bare of leaf and the leaf-buds are sprouting, they often crowd the treetops in large parties to pick the buds ; fresh, tender leaves are also eaten in quantities, not choosily picked as buds are, but guzzled. In this they may use their hands to strip boughs of foliage, but more often bend the leafy twigs to their mouths with their hands and bite off mouthfuls. In feeding on the buds of the giant bamboo, the monkeys are generally seen singly atop the culms (which cannot support numbers of them). Quite a few herbs, including the basal, succulent parts of certain grasses, are eaten. Eating buds and small fruit, they feed laboriously and over long periods picking each bud or fruit individually and conveying it to their mouth before picking the next : sometimes both hands are used to speed up the process, but economy of movement is not effected by several morsels being picked and then conveyed in a substantial mouthful to the lips. Feeding in this manner in exposed locations, their gregariousness has obvious survival value. At the sight of anything alarming, the individual that is alarmed bolts silently and the others follow it swiftly : there is no sounding of an alarm call.

Among the plants eaten, the following may be mentioned : the field notes contain records of the eating of many of these : besides these, a great many other species are also eaten. Food varies with the season.

Leaf buds : *Anogeissus latifolia*, *Bambusa arundinacea*, *Butea monosperma*, *Dendrocalamus strictus*, *Grewia aspera* and *G. tiliaefolia*, *Garuga pinnata*, *Zizyphus mauritiana* (TN 66 March 28, 66 April 9, 66 September 30 ; MP 69 March 7 & 14).

Twigs : *Grewia tiliaefolia* (TN 62 April 4).

Leaves and fresh shoots : Lantana, mango, neem, tamarind, teak, *Albizzia odoratissima* and other spp., *Anogeissus latifolia*, *Emblica* spp., *Garuga pinnata*, *Grewia tiliaefolia*, *Terminalia tomentosa* (young leaves), *T. arjuna* and *T. chebula*, *Wrightia tinctoria* and *W. tomentosa*, *Zizyphus trinervia* (TN 62 March 30, 64 March 28, 66 October 7; MR 68 November 26 & 27, 69 November 27 & 29 : photograph MR 15). Foliage is usually guzzled in bulk, and after a spell of feeding the stomach bulges prominently. The leaves and shoots of a number of cultivated plants in the ornamental garden at Taroba N.P. were also eaten eagerly—in fact, it was this garden that drew the langur to the rest-house area (MR 68 November 17 & 18).

Flowers : Mohwa, *Bauhinia racemosa* (unopened buds mainly), *Butea monosperma* (buds), *Bombax ceiba*, *Hibiscus lampas*, *Radermachera xylocarpa* (full-blown flowers eaten with avid zest) : (TN 59 March 6, a.m. & p.m., & 13, 66 April 10 & 12 ; MP 69 March 14 : photograph TN 17).

Fruits : Mango, neem, jamun, custard apple. *Aegle marmelos*, *Aporosa lindleyana*, *Bombax ceiba* (immature fruit), *Carissa carandas* and *C. spinarum*, *Cordia myxa*, *Diospyros melanoxylon*, *Emblica* spp., *Ficus glomerata*, *Grewia tiliaefolia* and *G. hirsuta*, *Terminalia bellerica*, *Santalum album*, *Zizyphus mauritiana* (TN 63 March 30, 63 September 14 and 22 ; MY 68 October 18 ; MP 69 March 10 ; MR 68 November 29 ; B 70 February 24).

Langur were seen digging and picking up something small from the forest floor and eating it, but it could not be identified (TN 62 March 26 ; MY 68 October 18).

Earlier observation of the drinking habits of langur was checked at the Mudumalai Sanctuary and Taroba N.P. (MR 68 November 22 : photograph MR 4). I have seen bonnet macaques scooping up the water in their palms and drinking it, when they were up trees and the water was in a hollow between the main forks of the tree. Langur invariably come down to drink, and while drinking crouch low, with the body close to the ground, and bend over to reach the surface of the water with their lips. They seem to distrust large sheets of water or deep rivers, and where possible prefer to drink from a pool of clear water in a hollow in a rock or ground, but will not drink muddy water. Apparently they do not enter the water to bathe or swim, though in heavy rains they get comprehensively drenched. Langur seen in the Moyar area of the Mudumalai Sanctuary, along either bank of the Maravakandy canal, invariably used the many bridges across the narrow canal to cross it.

There does not appear to be any defined breeding season, and young were seen in various stages of development to subadulthood from infancy both during summer and in the cold weather. Prater says that 'while mating may and does take place in any month of the year there is apparently a marked breeding season' and adds that 'in peninsular India most of the young are born between January and March'. Since it is not known on what evidence he came to this conclusion, it is difficult to differ from this guarded opinion, particularly as he was a careful and well-informed naturalist, but the personal and hearsay evidence at my disposal does not warrant such a conclusion.

THE NILGIRI LANGUR

Presbytis johni (Fischer)

(Summary of field notes : Observation records : 6.

Locations : Tamil Nadu—Topslip in the Anamalais : sholas along the road from Ootacamund to Gudalur. Kerala—Periyar Sa.

No Photograph.)

This is the only mammal whose position has improved during the period of this survey. Prior to 1959, sustained hunting for the sake of the handsome pelage and the flesh (credited with rejuvenating and therapeutic powers by superstition) had rendered it extremely fugitive, and driven it deeper into the remote evergreen sholas. Determined poachers pursued it into these retreats, where the chances of detection were much less. A combination of 3 factors seems to have contributed to the improvement in status of the black langur in recent years. Apparently poachers are finding the game increasingly less worth the candle, protection seems to be better organised, and in places the monkey seems to have taken to living in the deciduous forests around human settlements, where it is difficult to poach it furtively. Whatever the reason, the fact remains that this langur, threatened with local extinction in many locations, is now less rare, and less fugitive in places. My field notes show them as shy and hard to see in Topslip in 1960 (MISC 60 April 26 & 30) today it is almost common in the area.

Size : Morphological characters

The Nilgiri langur is more or less the size of the grey langur, shorter in the tail and slightly heavier in the body. The difference in adult size between the male and female and between members of a party is not great. The coat is sleek and glossy, black or a warm black, with the hair on the crown and the ruff around the black face a brownish grey. The young are a warm black: J. C. Daniel and Poirer specify the colour of the infant pelage as a reddish brown.

Distribution

This is exclusively a monkey of south India, like the liontailed macaque (with which it is found in places) and essentially a monkey of the sholas, though it may also be found in deciduous forests around. At present its range is restricted to the central and southern reaches of the Western Ghats and connected hills in Tamil Nadu and Kerala including the Palnis and other high elevations, and in these hills follows the discontinuous distribution of the sholas. Since these sholas have their own floristic variations and occur in comparatively small patches (mainly in the creases between hill slopes), and further since the black langur is not found in all these hill ranges (for example, it is absent from Kodaikanal),

a comparison of the typical semi-evergreen and evergreen sholas where it is found may lead to a better understanding of the langur's ecology.

Straightaway it may be said that it seems to prefer sholas in which is an admixture of deciduous species to the purer evergreen sholas.

In the Nilgiris, human activities have ousted it from many of its former haunts. The conversion of the shola forests in and immediately around Ootacamund into commercial plantations of exotics has shifted it farther out, but it is still there in the peripheral sholas, for example along the road from Ootacamund to Pykara, and from Pykara to Gudalur; after Gudalur, there are no evergreen patches, and the black langur is not to be found. The following trees are among those typical of these sholas of the Nilgiris: *Cinnamomum wightii, Cryptocarya neilgherrensis, Elaeocarpus munroii, Euonymis crenulata, Eurya japonica, Fragaea obovata, Ilex wightiana, Isonandra perrottetiana, Michelia nilagirica, Meliosma wightii, Photinia notoniana, Schefflera racemosa, Syzigium montanum, Viburnum hebanthum.*

This langur occurs in the sholas of the higher elevations of the Bolampatti range in Coimbatore, where the forests are little affected by human activities, and at my request M. Harikrishnan has provided the following brief account of the range.

'Bolampatti range: eastern slopes of the Western Ghats in the Coimbatore Dt. Elevation varies from about 300 to 1800 m. Rainfall increases sharply with elevation from about 850 to 5000 mm. Soil conditions are not uniform, though there is a general improvement with increase in rainfall and elevation. Patches of poor soil, however, occur at all elevations. The main peaks are Kunjaramalai (± 1800 m.) and Velingiri (± 1740 m.) and the ascent is achieved in about 12 km. At lower elevations there are rocky, dry deciduous patches containing *Sterculia urens, Cochlospermum religiosum, Givotia rottleriformis* &c. *Anogeissus latifolia* occurs on the fringes of such patches, and extends into the deciduous forests that form the predominant type of forest below approximately 750 m., where it reaches a large size. Other species of these deciduous forests are *Pterocarpus marsupium, Grewia tiliaefolia, Wrightia tinctoria, Dalbergia latifolia, Lagerstroemia lanceolata* &c. Around 900 m., the deciduous forests give way to a semi-evergreen to evergreen type of forest. Some of the trees here reach a height of 30 m., but most are smaller. The top canopy consists of *Toona ciliata, Artocarpus hirsuta, Hydnocarpus laurifolia, Elaeocarpus serratus, Mesua ferrea, Alstonia scholaris,* and *Bischofia javanica, Syzigium cumini* and *Mangifera indica* on stream banks. *Calophyllum elatum* and *Mesua ferrea* are the commonest species around 1200 m. Above 1200 m., *Mesua ferrea* forms almost pure patches in which the trees have short boles and large crowns. The lower canopy is almost exclusively evergreen with *Murraya exotica, Neolitsea zeylanica, Flacourtia montana,*

Schleichera oleosa, Cinnamomum wightii, Syzigium montana, Garcinia sp., *Diospyros* sp. & *Actinodaphne lanata* among the main components. Above 1500 m., montane sholas similar to the Nilgiri sholas make their appearance—short trees, all evergreen, with stunted boles and spreading crowns ; among the main species of this elevation are *Eurya japonica, Eugenia* spp., *Litsea* sp., *Meliosma simplicifolia, Memecylon malabaricum, Isonandra perrottetiana, Cryptocarya* sp. and *Euonymus crenulata.* The peaks are mainly herbaceous, with a few shrubs, among them *Hypericum mysorense, Rhodomyrtus tomentosa, Oldenlandia* sp., *Osbeckia* sp. &c. *Ochlandra* sp. occurs in moist patches between 800 and 1500 m. Elephants and the Nilgiri langur are said to be the main animals of these forests.'

Habits : Behaviour

The Nilgiri langur lives in comparatively small groups of from half-a-dozen to a dozen, and is much more arboreal than the other monkeys of peninsular India. It feeds mainly in the treetops, but descends to the ground to drink, and may occasionally feed on the berries and buds of the plants of the forest floor (K 70 Apr. 29). It does not associate with other animals in the treetops, and several groups do not unite into a large foraging party like the Common Langur. It seems to be exclusive, and in areas where it has taken up residence in the deciduous forests (as at Topslip), the grey langur seems to concede the locality to it. It is said to have much the same feeding habits as other langurs.

While feeding in the treetops, it was noticed, the members of a party did not keep more or less together, but were loosely dispersed (K 60 Apr., 70 Apr. 26). It was heard indulging in a rasping whoop, basically similar to the grey langur's whoop but different in tone: probably this helps members of a group to keep in touch with one another while feeding spread out. Inquiry of those who knew it in numbers in certain localities in the past does not show that it was socially more gregarious then. Fleeing from men in the tree forests, it did not descend to the ground in the manner of grey langur, but sought escape along the treetops (MISC 60 Apr. 26). However, it is said that where the forests are not extensive and the crowns of the trees close, it descends to run along the ground from one clump of trees to another. Besides men, leopards and wild dogs are the predators that hunt it, and both apparently catch it on the ground when opportunity offers.

Infant black langur were observed in March in the Nilgiris, and in April in the Periyar Sa. of Kerala (TN 56 Mar. 5, 66 Mar. 27 ; K 60 Apr. 7, 70 Apr. 26).

THE TIGER

Panthera tigris (Linnaeus)

(Summary of field notes : Observation records : 22, of which 18 were in the Kanha National Park, M.P., in May 1968, limited to 4 animals. Fresh pugs : 16. Other conclusive evidence of presence : 2.

Locations : Tamil Nadu—Mudumalai Sa. : Andhra Pradesh—Kawal Sa. ; Orissa—Balimela, Purnakote : Bihar—Hazaribagh N.P., Palamau N.P., the bed of the river Koel : Madhya Pradesh—Kanha N.P., Bara Naya Para : Uttar Pradesh—Corbett N.P.

Photographs : MP 4, MP 7, MP 9, MP 10, MP 11, MP 12 : B 11)

MORE has been written about the tiger than any other Indian animal but most of it has been about how to shoot it or, more often, how the author shot it ; there are even entirely anthropomorphic ' autobiographies ' of it ! Some of the habits and reactions of the tiger have been observed and reported by hunters such as Jim Corbett, and a closer study of it made by Dunbar Brander : some of this information has been taken into account in Prater's book, and a scientific and meticulously observed account of the tigers in the Kanha N. P., Madhya Pradesh, is furnished in Schaller's THE DEER AND THE TIGER. A great deal of information is available on the tiger in all this literature.

Size : Morphological characters

Adult size differs with individuals, but as a rule the male is considerably larger than the female. Dunbar Brander provides a factual and informed discussion of the size and weight attained by tigers. The ground colour varies from the off-white of the albinotic ' white ' tigers of Rewa through ochre to burnt sienna, and the shoulders and head may be lighter than the body in ground colour ; the abdomen, chest, chin, and insides of the limbs are also white in ground colour, as also a ' sun-spot ' above the eye, and the ruff above the cheeks. The stripes are variable in number, colour and formation, even in adults from the same litter, and further the ground colour and stripe spacing varies somewhat with age ; the stripes are solid and broad on the abdomen and the insides of the limbs (where the ground colour is white). The patch of white above each eye is marked with a varying pattern of black, but there is always a thin rim of white to the eyes ; the black spots on either side of the lips, from which the moustachial vibrissae arise, coalesce into thin bars, and high up the chin (near the mouth) there are some small black spots. The hair on the inside of the ears is white, and on the dorsal aspect of each ear the colouring is black with a large, prominent, almost white spot in the centre.

Many observers have commented on the obliterative or cryptic pattern of the tiger's coat, which is said to blend perfectly with the streaky appearance of tall grass and small bushes. It is obvious that to have any significance in its life, such colouring must have one or both of two functions : it may be protective and help in not betraying the tiger to its enemies, or it may be assimilative and help in not betraying the tiger to its prey. Apart from men, the tiger's chief adversaries consist mainly of other tigers, and ticks and similar parasites, so that the first aspect of the matter need not be considered further. In considering the value of the tiger's seemingly assimilative colouring to its hunting, it should be remembered that the perceptions of the prey species are not dominated by colour-sensitive vision, as ours are, and are more versatile, that so far as is known their vision is monochromatic and that the tiger hunts at night. Although it is often abroad and occasionally hunts by day, its hunting is done mainly at night. After sunset, a different kind of optic perspicacity governs even our colour-sensitive vision, for colour is no longer appreciable ; the ability to see clearly by low light levels, and to sense slight movements rather than static form becomes important. Further, like other cats, the tiger creeps upon its prey till near enough to attack in a rush, crouching low and taking advantage of every bit of cover, depending more on not being seen at all than on assimilative coloration—some observers, going by the lack of stealth of tigers at times in attacking tethered live baits, have overlooked the entirely artificial circumstances then obtaining.

The colouring of the tiger's coat is only a specific variation of a generic pattern, and it is in the leopard that such specific variation attains its most remarkable obliterative efficiency.

Distribution

Within peninsular India, the tiger has long been known wherever there were tree forests, and an adequate source of water (which could be quite small). Its present status (when in many of its former haunts it is now rare or locally extinct, and when in others its natural prey has been so depleted by hunting and trapping that its survival is endangered because in such localities it now constitutes a threat to cattle and men) strikingly illustrates the unpredictable consequences of interfering with the balance of nature, and also the fallacy of the theory that a little thinning of numbers for shikar will not affect a fast-breeding animal like the tiger. Within the past two decades, the tiger has declined so substantially, and even dramatically, in peninsular India that no reliable estimate of its numbers can be made, in view of the lack of dependable statistics, and it is difficult to make any firm statement on its present distribution in the peninsula, but it still seems to be there, in many of

its former haunts, though conditions in those areas have changed considerably and may speed its further decline.

Habits : Behaviour

In the Kanha N.P., in the first 12 days of May 1968, 4 tigers (2 adult tigresses and 2 male subadults about a year old) were seen by day on 18 different occasions. The 2 male subadults were the cubs of the younger and smaller tigress, and one of them was considerably bulkier than the other, almost as big as his mother ; the older, richer-coloured and much larger tigress seen once was said to be the mother of the young tigress (MP 68 May 1, 3, 4, 5, 6, 7, 9, 11 p.m.—photographs MP 4, MP 7, MP 11).

Apparently this was a family party, living under somewhat artificial conditions, with the younger tigress and the 2 subadults tied to the area by the regular provision of buffalo baits over a long period. In these circumstances it is hardly worth the while drawing conclusions, from observation of them, on the daily activity cycle of tigers, hunting and feeding, reactions to men and similar behaviour, but in other matters, such as intraspecific communications, avoidance of heat and glare, and instinctive responses they were no doubt entirely natural. Further, the conditions under which this family party of three was induced to stay more or less within two square miles of the Kanha meadow, and the repercussions of the sustained provision of inducements, are interesting.

The tigers were active in the mornings till about 8 a.m. after feeding on the bait killed at night ; then they lay up in the undershrub of a wooded nullah or in tall grass. Everyday they were disturbed in such cover by visitors to the sanctuary on elephant back till about 11 a.m., but only retreated deeper into the cover or shifted higher up the wooded hillock besides the nullah, though resentment of such disturbance was evinced even by the subadult tigers. Apparently they slept or rested in shade till evening, when they were again on the move. Usually they did not stay together, the 2 young tigers staying near each other, or one in the nullah and the other in the wooded hillock, and the tigress choosing different retreats not too far away. The heat and glare were fierce, and once the tigress was located deep inside a cool, dark cave ; twice she was seen cooling herself in rock-girt pools (MP 68 May 10 & 12 : photograph MP 12).

In May 1968, only this group of 3 (the smaller tigress and her 2 yearling cubs) were killing the baits provided, and had been accustomed to do so over a period of months. Evidently what had originally attracted the tigress to the area was the need to provide for growing cubs coupled with the assured availability of easy, staked-out prey. It was said that the larger tigress (the reputed mother of the smaller) had visited the

kills once or twice. There was another tiger in the forests beyond the Kanha meadow, a large male, but he did not come to the kill.

Once I found the smaller tigress lying up in a tussock of tall grass, and at our approach (on elephant back) she entered an extensive patch of tall grass across a forest road and proceeded, hidden by the cover, to where the larger tigress was lying up, about 100 yards away. Approaching the larger tigress, she came out with repeated low, vibrant, whining calls, reminiscent of the call used by a chained-up hound wishing to attract the attention of a man—these, evidently, were placatory, and the two tigresses were on amicable terms (MP 68 May 11 : photograph MP 11).

Although accustomed over months to being photographed and watched at night from the elevated, covered hide, while feeding with her cubs on the kill, and to being followed by visitors to the park on elephant back in the mornings, this group of tigers had not developed that indifference to human proximity that lions in similar circumstances develop, but were tense and resentful.

Schaller, analysing the reports of others and his own observation of the social interactions of adult tigers, says these are best understood in the three separate contexts of hunting, mating and feeding : he concludes that usually tigers hunt alone, that rival males attracted to a receptive female are antagonistic to one another, and that they ' appear to socialize more at kills than any other occasion '. He cites 3 detailed personal observation records in support of this, and it is noteworthy that in all of them the kill was by one particular tigress with 4 cubs, that the prey killed was domestic cattle, and that the tiger, and the 2 other tigresses, that were allowed to feed on these kills were, presumably, previously known to the tigress with 4 cubs. He further records that while the behaviour of this tigress was friendly towards the tiger, her acceptance of the other 2 tigresses at the kill was hostile ; it is interesting to note that superior size did not determine commensal priority, but that the ' owner ' of the kill seemed to have precedence.

There are many other instances, recorded by earlier observers, of 2 or more tigers feeding at the same kill, but as far as can be ascertained those tigers had previously accepted one another, and in many instances were closely associated.

Undoubtedly the findings of Schaller, Dunbar Brander and others, with regard to the sociability of tigers at kills, are entirely valid, but such records of commensal amiability, or unwilling mutual tolerance, do not exhaust the scope of this particular context, nor are the three contexts mentioned above the only main contexts of adult intraspecific interactions among tigers. There are records of tigers having appropriated the kills of others, and such appropriations were not, obviously, amiably permitted. Further, in commenting on the sharing of territory

by tigers, Schaller points out that once social dominance is established, in further encounters fights are avoided by the mutual acceptance of dominant or submissive behaviouristic expressions. In no animal is such acceptance immutable or unconditional. Other factors may condition such armed neutrality, such as the size and food-appeal of a kill, maternal instinct, or even emotional states. Sex also has to be considered. A tigress may not fight a tiger, but may resent the intrusion of another tigress into the area.

Moreover, artificial inducements and influences sometimes lead to internecine fights. In May 1968 I made diligent inquiry of the park officials at Kanha, and learnt that a few months previously another tigress, with one cub, was known in the area, but that she had been killed in a conjoint attack by the two adult tigresses I had seen (the mother of the yearlings, and her mother), in the very nullah occupied by the family party of three that I was observing. There was no reason for doubting the truth of this statement. I heard it from 4 different sources, two of them had actually seen the carcass of the dead tigress and the footprints and blood marks at the scene of the killing. Nothing was known of the fate of the cub with this tigress. Later in the same month, at the Corbett N.P. of Uttar Pradesh, where also baits were regularly tied out to attract tigers to the Dhikala area so as to display them to visitors, I learnt that a tiger had been killed in an intraspecific fight. In March 1969 no tiger was taking the baits staked out at Schaller Tower, Kanha, though I believe there were one or two kills when the baits were tied in different localities : only one set of fresh pugs were seen, of a tigress (MP 69 Mar. 10). There was a report of another tiger having been killed in an intraspecific fight since my previous visit, but no inquiry was possible. In March 1970, no tigers were taking any baits in the Kanha park : apparently no tigress with cubs had been attracted to the area.

Writing of the tiger's might eighteen centuries ago, the Tamil poet Paranar said that it was so powerful that it could kill and carry a bullock. Schaller records a tiger killing an adult bull gaur in the Kanha park, a much more impressive performance. I saw the freshly-killed carcass of an adult gaur cow in the Palamau N.P., killed single-handed by an adult male tiger well known in the area : the tracks showed where the tiger had attacked the cow, in tree forest, and later dragged the kill down a decline to the middle of a stony, open nullah where he had abandoned it, with no attempt to cover it : he did not return to the kill, which was lying close to a forest road. The remarkable feature of this kill (which was inspected by several others, besides me) was that there were no claw marks on the gaur's hide, and that the only wounds were two sets of two deep, punctured wounds, inflicted by the canines,

on either side of the nape ; the throat had not been bitten (B 69 Feb. 17 : photograph B 11).

S. R. Choudhury of the Orissa Forest Department related a quite remarkable instance of a tiger's self-assurance in making a kill, to which he had been an eye-witness. He was watching a line of elephants slowly going up a forested hill along a narrow ledge, from far away, when a tiger suddenly leaped on to the ledge from bush cover, made a lightning pass at a young calf, and retreated into cover before the excited adult elephants could intervene ; the attack was said to have lasted only a few seconds. The infant collapsed and later died, and after a long while the elephants, including the mother of the calf, left the carcass and went up the hill. I saw an interesting set of fresh footprints on the bed of the Koel, showing how a tiger had followed a party of elephants (which included an infant) part of the way across the dry river bed (B 68 Apr. 23). In the Palamau N.P., at Hathbajhwa, I heard a tiger growling from the dense cover behind the watch-tower, from which a young elephant calf had emerged, and saw a number of adult elephants entering the cover, presumably to investigate (B 69 Feb. 19, 4 p.m.).

Tigers will drink from a small, muddy puddle at times, when a river or pool is available not too far away, as noticed in the Mudumalai Sa. and also in Palamau N.P. (B 68 Apr. 27). The tigress observed in Kanha in 1968 was very sleepy by about noon, after feeding on the kill at night, but evidently mistrustful of reclining on the ground when men on elephant back were close by. Thrice, she left the tall grass cover in which she had been lying up when approached, and walked towards a boulder-strewn part of the forest about two furlongs away. On the first occasion, she stopped frequently to urinate, roll on her back, and lie down once briefly on a bare patch, in what seemed displacement activity ; then she went on to a rounded rock about 9-foot high and climbing it, stretched herself on top, in the shade of a young banyan that grew there : she watched us sleepily as the riding elephant slowly approached the rock and halted 30 feet from her, then her eyes closed partially as she rested her chin on her paws, still facing us. In another minute she was sound asleep, turning her body over on one side to relax fully. On the other two occasions she went to another rock nearby, also about 9-foot high, also with a banyan tree shading it, but growing on top with pillar roots close by the trunk : she ensconced herself in the corridor between bole and pillar, stretched flat on her stomach, and watched our approach from half-closed sleep-heavy eyes : as she watched us, her eyes closed to mere slits, her raised head began to nod, and finally dropped on to her paws, and she was asleep. This was no passive form of displacement behaviour, it was sleep all right, authentic, compulsive somnolence, probably induced by heavy feeding. Seated on the elephant, I was on a level with her and was able, by slowly

backing the elephant (the approach was intentionally made with the head of the elephant turned away from the rock) closer in by degrees, to get near, on one occasion getting as close as 12 feet from her nose by accurate rangefinder measurement.

She slept, so to speak, with eyes shut tight and ears wide open. Fairly rapid movements of my hands and body, the sounds made by the release and resetting of the camera's shutter and the winding on of the film, my directions to the mahout in a low tone and, later, even my whistling to make her look up, failed entirely to rouse her. I was positively anxious not to do anything that might panic her, as the impossibly contrasty lighting, with the overhead sun casting patches of dense shade and brilliant highlights all over, presented quite sufficient photographic problems without the added one of the subject bolting. However, in an attempt to get her to raise her head and open her eyes fully, loud clucks with the tongue were tried, to no effect. Everytime the elephant was moved, the noise of its feet on the litter-strewn ground made her open her eyes partially, for visual confirmation of her hearing, and I was able to get her to raise her head and stare sleepily only by making the elephant shuffle feet without moving. Her judgment of our position by ear alone was remarkable (MP 68 May 8, 10, 11 : photographs MP 9, MP 10—other photographs, showing this tigress with the head resting on her paws or on the rock, and the eyes closed or partly open, have not been printed for this report).

Besides vocalisations (of which Schaller provides a succinct account) variations in attitudes and deportment seem to play an important part in intraspecific communications, as in other cats. The staring ear-spot seems to serve as a flag only when the ears are pricked and seen from behind the tiger.

THE LEOPARD

Panthera pardus (Linnaeus)

(Summary of field notes : Observation records : 13. Fresh pugs and other conclusive evidence of presence : 7.

Locations : Tamil Nadu—Mudumalai Sa. : Orissa—Simlipal hills : Maharashtra—Taroba N.P.

Photograph : MR 6.)

Widely recognised as the most variable of the greater cats morphologically, at one time there was a distinction between a larger panther and a smaller leopard, but now it is realised that they represent only individual and ontogenetic variations of the same species. Currently, there is a revival of taxonomic interest in possible regional races, even

within peninsular India. The black leopard is only a melanistic variation, generally found in the denser and more evergreen forests ; its reported smaller size seems entirely due to its much darker ' whole ' colour.

Size : Morphological characters

Adult size varies widely, from near 6-foot (between pegs) to 8 feet, but this gives a poorer indication of size than weight, as the length of the tail has no relation to body size. Weights vary from 60 to 160 lb. These variations are not regional. In personally verified records of the length (between pegs), weight, and pelage patterning of 14 leopards shot (by others) in the same area of the Deccan during the forties, the following are included :

1. Adult male, 6′ 1″ long ; weight 64 lb. The coat was short, smooth, and very richly patterned with close-set jet-black spots and rosettes on a fulvous burnt sienna ground, with the ground colour of the abdomen, chest, chin, the sides of the jaws, the inner aspects of the limbs and the distal part of the long tail conspicuously white.
2. A male in his prime, 7′ 7″ long : weight 158 lb. The abdomen was tucked in, and when cut up the stomach was empty ; when gorged this animal would have turned the scales at close on 170 lb. The coat was raw sienna in ground colour, with the chin, a small ruff, the chest, abdomen and the insides of the limbs off-white, and black spots and small rosettes.
3. An old male, heavily built and with a domed head. Mistaken for a tiger in the evening light. Length 7′ 1″, tail 32″ ; weight 132 lb. The extraordinary feature of this animal was that the chin, chest and abdomen were a light yellow ochre, even the hair inside the ears. The body colour was a deep, dull ochre and the spots and rosettes indistinct against the ground colour, being a graphite-grey rather than black. Coat short and close.
4. An old male, 7′ 7″ long ; weight 121 lb. Head small. Coat furry, tail long and furry. Ground colour of body a pale fulvous grey. Spots small and few, even along the median line of the back ; many double rosettes, with the inner circle consisting of spots and the outer not heavily marked but delicately pencilled.

The ear-spots are present, as in the tiger, but much less noticeable, perhaps because of the spotted coat.

Distribution

It has often been said of the leopard that (even within peninsular India) it has a much wider distribution than the tiger, being much smaller, more versatile in its hunting, more tolerant of the heat and less demanding in its requirements of cover, being well able to thrive in open country, in rocky hills and thorn-scrub.

That was the position 25 years ago. In the recent past the leopard has declined notably in open country and around human settlements

in peninsular India, partly owing to the conversion of scrub to human uses and partly to having been shot out and poisoned. It is now to be found mainly in certain favoured localities, such as sanctuaries, and is almost or completely rare in many locations where it was common formerly.

Habits : Behaviour

The literature on the leopard as a big game animal is extensive and contains much evidence on its unpredictable variability, but meagre in circumstantial accounts of its habits. A male and a female are sometimes seen in a pair, as also a leopardess with young cubs, but the period of association between cubs and mother seems shorter than in the tiger ; perhaps the cubs grow up faster.

The size of its prey depends, naturally, on the size of the leopard. It is generally agreed that sambar stags and bull nilgai are left alone by leopards, but at Chilkanahatti (in Mysore State at present) a big leopard killed a bullock. Subadult and young sambar and nilgai are no doubt preyed upon, as also young gaur calves if they can be safely attacked. A leopard is not able to kill even a goat quickly, with a blow of its paw or one bite, as tigers do at times, and therefore it has to study safety in attacking the young of large animals. A small leopard on a fallen tree trunk was seen closely watching a herd of gaur in which there were 3 young calves ; seeing me (on elephant back) the leopard dropped into the grass below and seeing it, two gaur cows rushed towards it with lowered horns and the leopard bolted (TN 62 April 7, p.m.). On another occasion, 3 gaur cows topping a rise saw a big male leopard ascending the rise from the other side, and after a momentary halt and sharp, nasal snorts, rushed at the leopard with lowered heads and the leopard bolted (TN 59 Mar. 22, a.m.). In both instances, the gaur rushed at the leopard at a fast walk, not a gallop.

A small adult female, followed at a distance on elephant back, urinated repeatedly, rolled on her back on the ground with all four feet in the air, and when moving fast, melted into a grey blur (TN 63 Mar. 19, p.m.). The almost completely obliterative disruptive colouring of a leopard in tangled tall grass or thorn-scrub has been remarked upon by many observers, and is no doubt of value to an animal that is abroad so much by daylight (TN 63 Mar. 25, a.m.) ; however the remarkably disruptive effect of the coat when the animal is moving fast has not received the attention it merits ; unlike a tiger, a leopard crossing even open ground at a fast pace is difficult to follow visually, because the effect of movement is to create, not a grey form with contour sharpness, but a grey blur. I have noticed this both by daylight and by artificial light (spotlight) at night—the only other Indian animal that also gets blurred by movement is the porcupine, but that is no doubt achieved

in part by the outbristling of the quills, and anyway is much less obliterative. This is perhaps of some value to the leopard in its getaway from large animals chasing it, such as gaur and tiger.

When moving away from men, or other animals such as gaur or elephants, leopards run or slink into bush cover or into tall grass, and often squat low in the cover, but are said to climb trees when a tiger is near or wild dogs on their trail. Tigers are their chief natural enemies ; many instances of wild dogs chasing leopards are on record. Occasionally, a leopard may seize a wild dog—I have heard of such an instance.

A very full account of the varied prey on which leopards subsist is provided by Dunbar Brander in his book. When hunting monkeys they sometimes climb trees, apparently to scare the prey into leaving the tree and seeking escape across the forest floor, when it can be seized : sometimes they hunt monkeys in a pair.

It is said that leopards are much less dependent on water than tigers. They do not lie up in water as tigers do, but drink regularly, particularly after feeding. As in the case of the tiger, a small water-hole or puddle will suffice for them, and in saying they can do without water, the human observers have apparently missed such inconspicuous sources.

Langur, macaques, barking deer, chousingha, chital, sambar and a number of birds (including the peafowl) sound alarm calls at the sight of a leopard, as at the sight of a tiger. Both the giant squirrel and the common striped squirrel also call at a leopard, the former in a more urgent variation of its normal rattling call, and the latter in an excited sustained chirrup.

Unlike young tiger cubs, leopard cubs are highly vocal at times, till about 2 months old. Their call then is a repeated, plangent, long-drawn, rasping mew, and presumably addressed to their mother when she is not in sight, for it is not sounded when she is at hand. The grunt and snarl of the adult, as well as the peculiar call reminiscent of the thrust and return of a wood-cutting saw, are well-known.

The leopard's addiction to spitting and hissing like a wild cat, when expressing resentment (as when demonstrating at men) should be mentioned (TN 63 Mar. 25, 69 Oct. 3).

Leopards seem even more prone to residence within a limited range, when their requirements are met locally, than tigers.

THE JUNGLE CAT

Felis chaus (Güldenstaedt)

(Summary of field notes : Observation records : 22.

Locations : Tamil Nadu—Mudumalai Sa. : Orissa—Badrama : Bihar—Hazaribagh N.P., Palamau N.P., Karkatnagar : Madhya Pradesh—Kanha : Maharashtra—Taroba N.P.

Photograph : B 9.)

Domestic cats, run wild, are not uncommon in the scrub and forests around human settlements. Where there is some white or patterned stripes on the coat, these are easily told apart from the jungle cat, but the larger size of the latter, as specified in faunal literature, does not appear to be a reliable criterion for distinguishing between the two. In the identical location (for instance, the Hazaribagh N.P., Bihar) the animal is to be found of the stature and coloration of textbook descriptions, and also of the same colour but only about half the size of the larger animal, and these smaller specimens, closely observed, were seen to be quite adult. Inquiry of others likely to know about the possibility of hybrids between the feral domestic cats of India and authentic *Felis chaus* have yielded no definite information—the coloration of these smaller-sized Jungle Cats is substantially the same as that provided in faunas, except that there seems to be a greater admixture of brick red in the grey than in the descriptions, especially in the Taroba N.P. of Maharashtra. There is some variation in size even among the smaller animals seen, some being only the size of a big domestic tom (approximately 5-6 lb. in weight) and others somewhat larger. All cats seen in the forest of a general predominantly fulvous or reddish grey colour with no dark markings on the flanks, with the tail short and ending in a dark tip with a few rings above the tip, and pointed ears, edged with black or dark grey, have been taken as Jungle Cats in this report. (MR 68 Nov. 19, 20, 21, 24 ; B 69 Feb. 20, 70 Feb. 23 ; TN 70 Oct. 3).

Size : Morphological characters

Variations in size have already been mentioned. Some large specimens, of the size specified in faunas, were also seen (B 69 Feb. 14 : photograph B 9). In specimens seen, a dark line running down from the inner lower corner of each eye down to the nose (on either side) was observed. In subadults, there were dark bars on the inner aspects of the upper half of the forelimbs and on the abdomen (B 69 Feb. 21 & 22, 70 Feb. 26).

Distribution

Throughout peninsular India, in open forests and scrub.

Above : KERALA 1970 : PERIYAR SA. : May 9 — a.m. : Herd of 20 elephants : Cow feeding on tree foliage — K. 41 ; *Below :* KERALA 1970 : PERIYAR SA. : May 10 — p.m. : Cow and calf scenting us — K. 43.

(*Photos : M. Krishnan*)

Above : MISCELLANEOUS : Jaldapara, WEST BENGAL : 1965 October 22 — a.m. : The Killer of Shibji — MISC. 2 ; *Below* : MISCELLANEOUS : Kaziranga, ASSAM : 1965 February 4 — p.m. ; Tusker eating water hyacinth at Bimoli bheel — MISC. 3.

(*Photos : M. Krishnan*)

Habits : Behaviour

On occasion a cat was seen to pounce on something small on the forest floor, and to crunch it up, most probably a grasshopper or similar insect. 4 adults were seen crouched immobile in the open, near water, and in a bush near an artificial salt lick, evidently lying in wait for partridges, doves and other birds visiting the water and lick (B 68 Apr. 26, 69 Feb. 20, 70 Feb. 23, 70 Feb. 27 ; TN 64 Sept. 27, 70 Oct. 3 & 4).

Grown kittens were seen in the Palamau N.P., Bihar, in February 1969 and 1970.

THE SMALL INDIAN CIVET

Viverricula indica (Desmarest)

(Summary of field notes : Observation records : 18.

Locations : Tamil Nadu—Mudumalai Sa. : Orissa—Badrama, Simlipal Hills : Bihar—Hazaribagh, N.P. : Maharashtra—Taroba N.P.

No photograph.)

This is the common civet of peninsular India and mainly nocturnal.

Size : Morphological characters

Larger than the Common Mongoose, standing higher, and heavier-built. Length about 3 feet. Weight around 6 lb.

Distribution

All over the peninsula, in open deciduous forests and scrub jungles ; common around villages.

Habits : Behaviour

This civet was seen alongside forest roads at night, usually singly. A pair (probably mother and near-adult young) was twice seen on the periphery of the Taroba lake (MR 69 Nov. 20, 25). Although it climbs trees, it was always seen on the ground. In addition to feeding on small animals, berries and the like, it preys on insects, like beetles and grasshoppers.

This civet has an interesting history in the Deccan, where, till about 30 years ago, it was often tamed and given the run of the house, being an excellent ratter. The perfume, civet, is extracted from it, and formerly it was much valued as the provider of it, but for that purpose it was kept closely caged, the civet being rubbed off on the bars of the cage from its sub-caudal scent-glands, and scraped and collected.

THE COMMON PALM CIVET

Paradoxurus hermaphroditus (Pallas)

(Summary of field notes : Observation records : 7.

Locations : Bihar—Palamau N.P. : Madhya Pradesh—Shivpuri N.P. : Maharashtra—Taroba N.P.

No photograph.)

The ' toddy cat ', so called from its tendency to drink the sweet juice from the pots of toddy-tappers (the name ' palm civet ' has much the same derivation), is a much more arboreal animal than the civet, though it also hunts prey on the ground. It is nocturnal, like the civet.

Size : Morphological characters

About 3-foot 6-inch to 4 feet long, and around 8 lb. in weight. It is a low-to-ground creature that seems larger than it is because of its long, coarse, dark hair.

Distribution

All over the forest and scrub areas of the peninsula : not uncommon in urban areas.

Habits : Behaviour

The palm civet, like the civet, lives on small animals (including insects) and fruits, but finds its prey as often up a tree as on the ground : it preys on birds and raids their nests. In urban areas, rats seem to be its main prey. For years an untamed palm civet shared my tiled cottage and unkempt garden with me, and I have seen it hunting palm squirrels on my roof at night.

It is often found inside tree forests (MP 69 Mar. 31 ; MR 68 Nov. 21 ; 69 Nov. 25, 29 ; B 70 Feb. 21).

The eyes of few mammals reflect artificial light beams at night (such as a spotlight) as brilliantly as the palm civet's.

THE COMMON MONGOOSE

Herpestes edwardsi (Geoffroy)

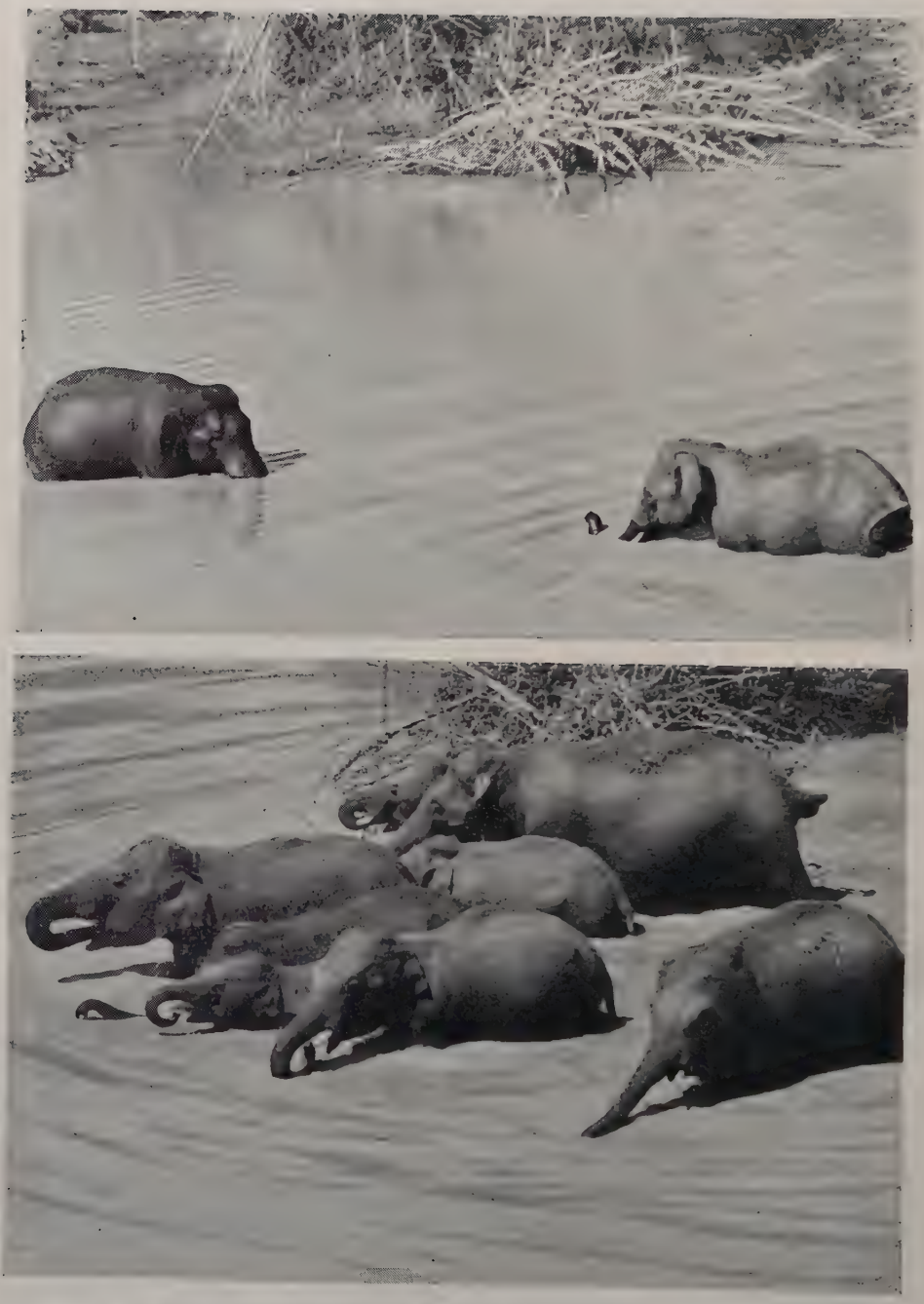
(Summary of field notes : Observation records : 20.

Locations : Tamil Nadu—Mudumalai Sa., Pt. Calimere Sa. : Mysore—Bandipur Sa. : Bihar—Palamau N.P., Karkatnagar : Madhya Pradesh—Bastar : Maharashtra—Taroba N.P.

No photograph.)

Above : MISCELLANEOUS : Kaziranga, ASSAM : 1968 February 10 — p.m. : The muckna at Bokani bheel — MISC. 4 ; *Below :* MISCELLANEOUS : Corbett National Park, UTTAR PRADESH : 1968 May 18 — p.m. : Tusker drinking at the Ramganga : Note extensile trunk — MISC. 5.

(*Photos : M. Krishnan*)



Above : MYSORE 1968 : BANDIPUR SA. : October 9 — a.m. : The 2 young tuskers in the water, Kollakumalikatté — MY. 3 ; *Below :* MYSORE 1968 : BANDIPUR SA. : October 9 — a.m. : Part of the herd entering the water, Kollakumalikatté — MY. 4.

(*Photos : M. Krishnan*)

The Common Mongoose is one of the few wild animals of India that most people know, in a somewhat anthropomorphic way as the killer of cobras. I have not seen a really big mongoose with a snake-charmer.

Size : Morphological characters

The male is larger than the female. The average length of an adult is 3 feet ; weight 3-4 lb.

Distribution

This mongoose is common all over the peninsula, and is essentially an animal of the open scrub.

Habits : Behaviour

This mongoose appears to be mainly diurnal. Wild mongooses were seen moving actively at all times of the day, even during the hottest hours. It is unreliable going by the activity cycle of tame animals, fed regularly, but most of the hunting seems to be done in the mornings and evenings. However, mongooses are met by night as well (MR 68 Nov. 19) : family parties of a mother followed by 3 or 4 young in a train, are usually crepuscular.

The mongoose is essentially a hunter, but its diet is varied with berries and other fruits, and it eats beetles, grasshoppers, birds and their eggs, lizards, snakes and frogs, as also small mammals like rats and mice. I have personally known it to kill a hare bigger than itself, and once saw a big mongoose carrying a fair-sized bird that looked like a stone-plover, considering the surroundings more probably a stone curlew (*Burhinus oedicnemus*)—MY 68 Oct. 19. At Point Calimere I noticed, shortly after dawn, numerous mongoose tracks leading from the littoral scrub to the foreshore and meandering along it, suggesting that crab-hunting at night was indulged in.

THE STRIPENECKED MONGOOSE

Herpestes vitticollis (Bennett)

(Summary of field notes : Observation records : 6.
Locations : Tamil Nadu—Mudumalai Sa.
No photograph.)

This large mongoose attains an almost otter-like thickness on occasion, though it is much smaller in proportion.

Size : Morphological characters

Much heavier than the Common Mongoose, though only about the same length (3 feet). Prater gives the weight at 7 lb. In the same area,

some animals are much darker (TN 63 Mar. 17) : the distinctive stripe on the neck is visible in a good light even in such animals.

Distribution

Along the Western Ghats, in deciduous forests. In these, it is usually seen in swampy clearings, along watercourses, and in open scrub, though it certainly does enter tree forests also.

Habits : Behaviour

Although it hunts small prey, like insects and frogs, it also preys on animals as large as itself or larger. A stripenecked mongoose was seen chasing a young chital fawn in the scrub (TN 70 Sep. 20). A captive specimen I know was fond of bananas. A certain amount of vegetable food is also taken.

THE STRIPED HYENA

Hyaena hyaena (Linnaeus)

(Summary of field notes : Observation records : 4.
Spoor and call : 2.
Locations : Tamil Nadu—Mudumalai Sa. : Orissa—Simlipal hills, near Sambalpur : Bihar—Hazaribagh N.P., Palamau N.P.
Photograph : B 23.)

Prior to the period of this survey, I have seen the hyena now and again in fairly open forests interspersed with scrub. Very few were seen in the forested areas in which most of the work was done after 1959, but no doubt they were there. Being mainly nocturnal, and going about in a pair or by themselves, they are seen seldom, and then only by chance, in the course of night drives along forest roads. No attempt was made during the survey period to locate and observe hyenas.

Size : Morphological characters

The enormously powerful, bone-cracking jaws, the fall off to weak-seeming hindquarters and legs from the strong forequarters, and the dorsal crest of thick, long, fine hair are the main physical attributes of the hyena. Prater gives the height at the shoulder at 3 feet, and a weight of 85 lb. for a male. The spoor is unmistakable, with the imprint of the big forefeet so much bigger than that of the compact hind feet.

Distribution

The striped hyena has a wide distribution in Asia, and Africa. In peninsular India it is found both in forests, and more commonly in rocky, ravine-cut, bush-clad country.

Above : MYSORE 1968 : BANDIPUR SA. : October 9 — a.m. : The herd in the water spreading out in a semi-circle : Note outreaching trunks — MY. 5 ; *Below :* MYSORE 1968 : BANDIPUR SA. : October 11 — a.m. : Blunt-tusks and sharp-tusks — MY. 7.

(*Photos : M. Krishnan*)

Above : MYSORE 1968 : BANDIPUR SA. : October 14 — p.m. : Tusker covered with mud, near Yerekatté — MY. 9 ; *Below :* MYSORE 1968 : BANDIPUR SA. : October 21 — 5.15 p.m. : The tusker that followed our ground-scent to Sullukatté — MY. 10.

(*Photos : M. Krishnan*)

Habits : Behaviour

Well known as a carrion eater and as a feeder off the kills of other animals, the striped hyena in India has not received the serious attention of naturalists. There are records of its appropriating a leopard's kill, driving off the legitimate owner of the kill—these are interesting, in that a fair-sized leopard may kill a big dog the size of a hyena, and suggest that the hyena does put its great jaw-power to aggressive or defensive use on occasion. There are also records of its carrying away dogs, and occasionally, infant animals and even children. As against this when hunted with dogs it has been known to sham dead instead of fighting its way clear, enduring the worrying and the bites of its hunters. Col. R. W. Burton assured me that taken young and tamed, it is quite dog-like in its attitude to men. Zoo specimens often get quite attached to their keepers, and others they know.

The vocalisation associated with the hyena is its discordant, cackling ' laughter ', which seems to be indulged in when it is excited. It also comes out with a high, nasal whine that tails off to a whimper, similar to the whine of a dog ' calling ' a man, when trying to attract attention. In 1955, a hyena in the People's Park at Madras was deeply attached to the late B. V. Ramanjulu, who was then the Superintendent of the zoo. On several occasions I have been a witness to this hyena scenting him, when he was invisible to it, and calling to him with loud whines, which would change to a staccato cackling when he came up and stroked it. Hyenas have a very fine nose.

Another sound commonly used by a pair out on a prowl, and separated from each other by a short distance, is a high, querulous ' kow ', somewhat long-drawn and declining in volume. I investigated this call, often heard at night along a stony nullah near Krishna Nagar in Sandur (now in Mysore State) and on two occasions was able to observe the hyena calling : the call was answered by its mate, from about a furlong away.

THE JACKAL

Canis aureus (Linnaeus)

(Summary of field notes : Observation records : 25.

Locations : Tamil Nadu—Mudumalai Sa., Pt. Calimere : Andhra Pradesh—Pakhal Sa.: Orissa—Tickerpara, Simlipal hills, Chilka : Bihar—Hazaribagh N.P., Palamau N.P. : Maharashtra—Taroba N.P.

No photograph.)

No attempt was made to locate and study jackals specifically during the period of this survey, but prior to it and in rural localities, I have had opportunities to watch them closely.

Size : Morphological characters

Prater gives the height as from 15-17 inches and the weight as from 17-25 lb., and adds that animals from North India are larger and heavier. Perhaps he means the sub-Himalayan areas, but neither in the northern parts of peninsular India nor even in U.P., north Bengal (near Bhutan) and Assam were the jackals seen noticeably larger than in the South. The largest jackals I have seen were in the Pulneys.

Very dark, almost black jackals (said to be not uncommon in N. India) are quite rare in the peninsula, but occur in the south-west. Animals almost entirely tawny are also seen occasionally.

Distribution

All over the peninsula : commoner around forest-side villages than in forests.

Habits : Behaviour

A great deal has been written about jackals as scavengers and as the camp-followers of tigers. It is significant that the 'pheal' of Anglo-Indian shikar literature is said to attach itself to tigers and not to leopards—the latter prey on jackals.

Jackals living along the coastline are much given to hunting crabs at night along the foreshore (TN 68 Dec. 12). Apart from feeding on carrion when it is available, they hunt whatever they can overcome, from field mice to the fawns of chital. When hunting larger prey, sometimes they may run in a pack, but usually they hunt alone. Among the fruits eaten are ripe mangoes, the ripe drupes of the lantana, and *Zizyphus mauritiana.*

At sunset jackals usually come out with a concerted howling, one animal starting the howling which is taken up by others near it. The purpose of this vocalisation is not clear, but it is probably an assembly call. This evening chorus of jackals, once one of the most familiar sounds of the Indian countryside, is no longer to be heard in many of the areas where it was common. No doubt the occupation of the plains country by humanity is partly responsible for this, but since this chorus is mainly a feature of jackals living around human settlements, this cannot be the explanation of the decline of the familiar noise.

THE DHOLE OR WILD DOG

Cuon alpinus (Pallas)

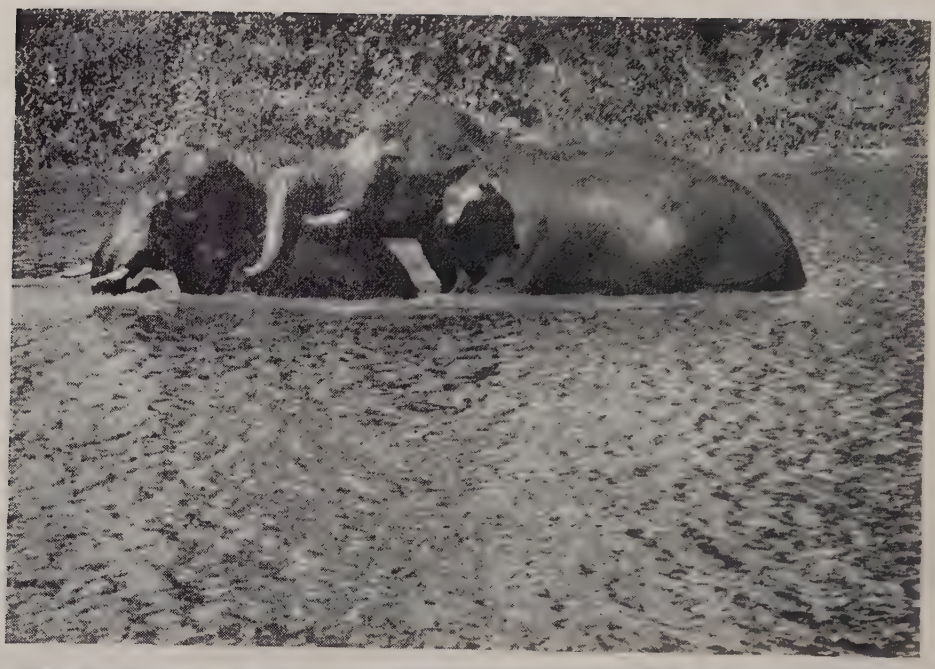
(Summary of field notes : Observation records : 25.

Locations : Kerala—Periyar Sa. : Tamil Nadu—Mudumalai Sa. : Mysore—Bandipur Sa. : Madhya Pradesh—Kanha N.P. : Maharashtra—Taroba N.P.

Photographs : K 28 MY 11.)

Above : MYSORE 1968 : BANDIPUR SA. : October 25 — 2.15 p.m. : Elephants bathing in Yerekatté — MY. 16 ; *Below :* MYSORE 1968 : BANDIPUR SA. : October 25 — 3 p.m. : The koomeriah in Kollakumalikatté. Note outwardly directed spout from the trunk and the ridge of water thrown up by the downward slap with the tusks — MY. 17.

(*Photos : M. Krishnan*)



Above : MYSORE 1968 : BANDIPUR SA. : October 26 — 10.15 a.m. : The 2 tuskers in Tavarakatté — MY. 19 ; *Below :* MYSORE 1969 : BANDIPUR SA. : October 10 — 11.30 p.m. : 4 cows and a young calf in Kollakumalikatté — Note duckweed — MY. 22.

(*Photos : M. Krishnan*)

The history of human hostility to the wild dog in India during the present century is both interesting and significant, as showing a strong biotic bias that is independent of cause-and-effect reasoning, motivated largely by unverified prejudice, and sentiment. No other animal has incurred the antagonism of man without doing him any demonstrable harm. No instances are on record of wild dogs having killed or injured men in the many brushes between them ; though they have been known to kill cattle on occasion, these killings are so few and far between that they may be ignored and, moreover, have never been cited as a reason for outlawing the predator and, being a thoroughgoing carnivore wild dogs have never done any harm to crops. Moreover, being a comparatively small animal whose head provides no worthwhile trophy and whose pelage loses its lustre with death, it has never been considered a game animal. But still there has been a reward on the head (and brush) of the wild dog till recent times and even today the dominant impulse of men with guns on seeing the animal is to shoot it.

Only one justification has been adduced for this implacable hostility and it is valuable in its way as showing the sustained and ubiquitous interest of men in hunting the very animals that the wild dog hunts, especially deer—it is a hostility sustained by a sense of competition. Hunters proceeding to some area noted for its game, to shoot, have found the game animals wary, elusive, and scattered, and have attributed this scarcity and vigilance to the earlier visit of wild dogs to the area. In this they are probably less correct than they think. If, as it is repeatedly asserted in shikar literature, all the deer and other herbivores at once abandon their homes and shift the moment wild dogs appear in their area (presumably to near-by areas where they are safe from wild dogs) it is difficult to understand how the wild dogs are able to find prey or why they (among the most persistent followers of scent trails) do not follow their retreating prey.

And it is not as if these sportsmen did not know two highly relevant aspects of this question, first the fact that wild dogs and their prey are often found in the same area and second that for thousands of years the two had coexisted without the prey species having died out.

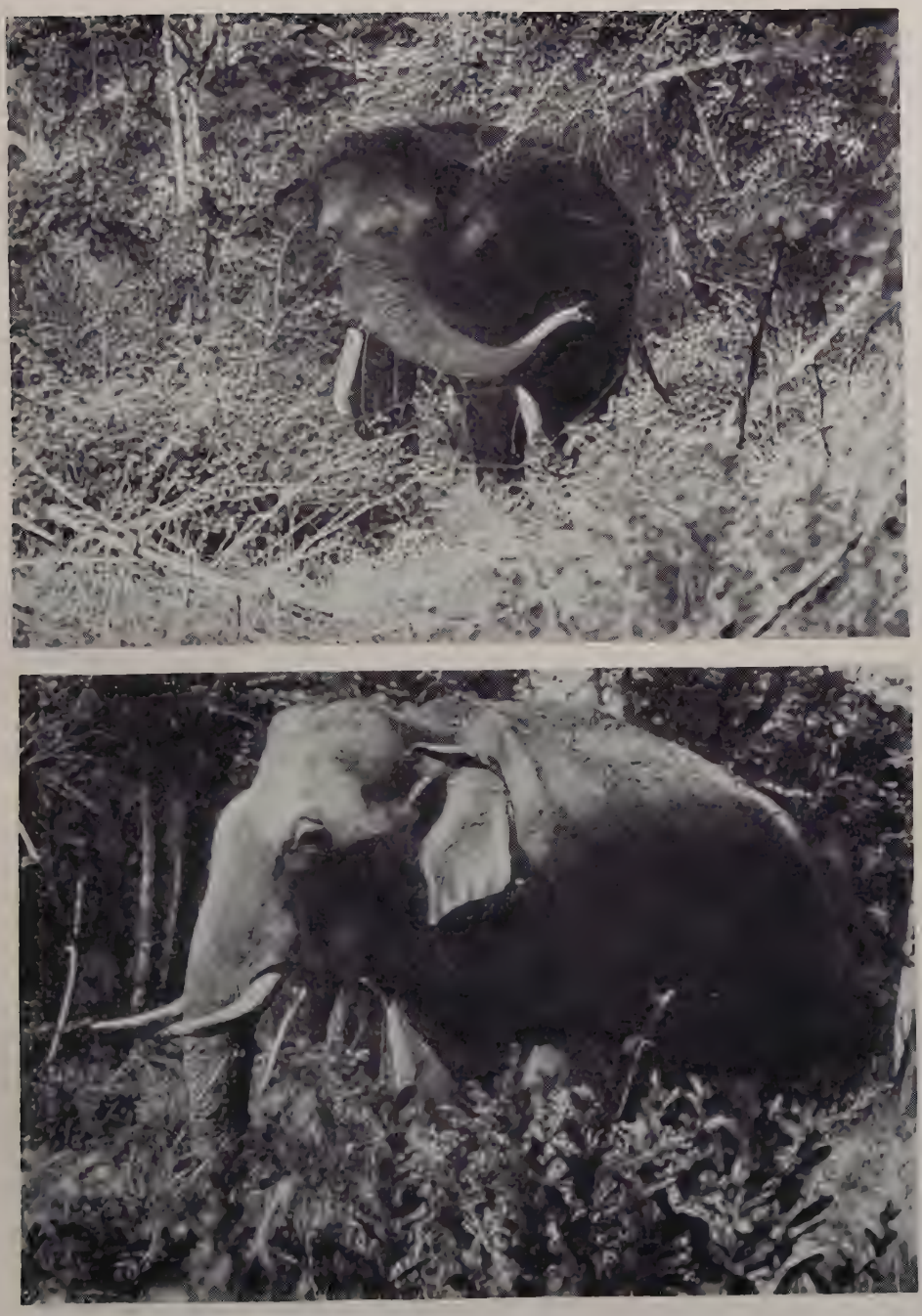
There are records of sportsmen having seen wild dogs lolling on the ground in plain view of chital and sambar which just ignored them, since the dhole were not hunting. To provide reason for raising the government reward on the head of wild dogs, Glasfurd puts forward the theory that they have suddenly increased in numbers. The periodic fluctuations in the wild dog population of an area, the apparent sudden increase and subsequent sudden decrease, which cannot be adequately explained entirely by influx and efflux but is also caused by actual increase and decrease in numbers, has been selectively cited to show that these ' vermin ' should be sternly put down. The role of wild dogs in main-

taining the balance of nature has been consistently ignored, though F. W. Champion makes out a weak case for them. The truth seems to be that human hostility to the wild dog is largely based on compassion for their victims, on the ruthless and piecemeal killing methods of the predators, which being small compared to their prey are sometimes unable to kill them swiftly, though they do attack in numbers and pull down and kill the prey quickly quite often.

Size : Morphological characters

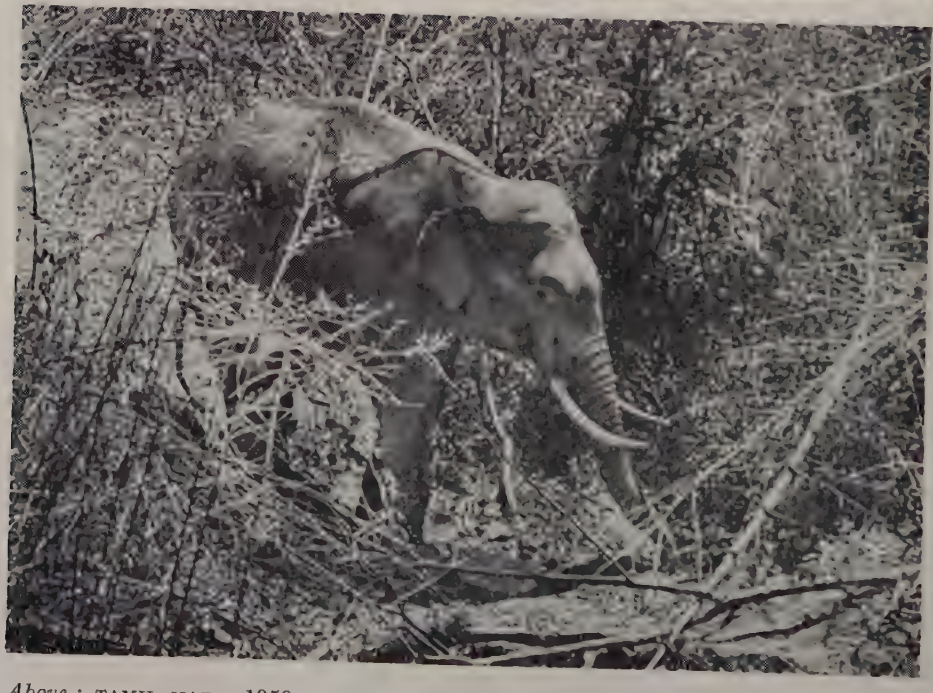
Size and even colour vary somewhat with locality and individuals. A comprehensive account of the appearance and other characteristics of the dhole is provided in a note by Col. R. W. Burton (*JBNHS* 41 (4) : 691-715) which sums up most of the information available up to 1940. Generally speaking, the dhole is from 17 to 22 inches in height and from 30 to 45 lb. in weight, with what dog-fanciers term a red coat : the brush, carried below the level of the back, has a terminal tuft of long black hair, sometimes with a core and tip of white hair. In an old dog, the back may be dark and grizzled, very much in the patterning of a jackal's back (TN 63 Sep. 30) : a little white may be found on the toes, or on the chest or throat (MP 69 Mar. 14). In profile the face is somewhat downfaced, and the muzzle deep, both characteristics shared by no breed of Indian domesticated dog.

The genus *Cuon* is distinguished from *Canis* (the genus of the wolf, the jackal, and all domesticated dogs) mainly by there being one molar less on each side in the lower jaw, and the bitch having about 14 teats instead of 10. The close resemblance of the dhole to red-coated countryside dogs (red, warm sienna and brown are the colour of countryside dogs of unmixed blood, termed ' pariah ' by canine experts) has been remarked by many observers. Forsyth (THE HIGHLANDS OF CENTRAL INDIA) was confused by the similarity of the tribal pariah dogs of the Upper Narmada forests to the dhole, and thought those dogs were descended from the latter. Burton, arguing the case further in his note, says that jackals have been known to interbreed with the dhole, and also with domesticated dogs, and cites the instance of ' a wild dog bitch with her two pups, sired by a jackal in the Mysore Zoo in November 1930 ', and sees no reason why interbreeding between dhole and domesticated dogs should not result in a breed of red-coated domesticated dogs. Apparently the extreme likelihood of the progeny of such far-fetched matings being infertile was not considered by him. In view of the taxonomists being almost certainly entirely correct in their separation of the genus *Cuon* from *Canis*, the name ' wild dog ' seems a misnomer for *Cuon alpinus* and it seems advisable to adopt the other vulgar English name (derived from Indian languages) and term this animal ' dhole ' : the desirability of keeping such derived names (gaur, langur



Above : MYSORE 1969 : BANDIPUR SA. : October 11 — a.m. : Lone tusker feeding on twigs — MY. 23 ; *Below :* MYSORE 1969 : BANDIPUR SA. : October 25 — a.m. : Big lone tusker near road to Moolapura — MY. 35.

(*Photos : M. Krishnan*)



Above : TAMIL NADU 1959 : MUDUMALAI SA. : Benne : March 30 — noon : Tusker having a mud bath — TN. 5 ; *Below :* TAMIL NADU 1959 : MUDUMALAI SA. : Benne : March 30 — past noon : Tusker drinking at a water-hole — TN. 6.

(*Photos : M. Krishnan*)

and barasingha provide other examples) pure by interpreting them to include the plural as well as the singular (as they include in the Indian languages from which they are derived) may also be mentioned here.

Distribution

Within peninsular India, the dhole is essentially a forest animal, and is not found in open country.

Habits : Behaviour

A great deal has been written about the destructiveness of the dhole, and also its method of hunting. Although usually running in packs and parties, it may also hunt alone, as when breeding, and at such times it is probably looking for small, easily available prey, such as hares and field rats, though it can pull down a chital hind or a small pig single-handed. A single male was observed regularly quartering an extensive patch of scrub at an easy run, with its head held high, scanning the ground in front of it ; occasionally it took a high jump to look over the bushes limiting its vision (TN 62 Sept. 26). Packs usually go for large animals, such as chital, sambar or pig. Although it is known to kill cattle (especially young animals) once in a way, inquiry of the herdsmen in the Tamil Nadu and Mysore forests around the river Moyar, where cattle are grazed in thousands and dhole are common, elicited the information that as predators affecting cattle they were negligible : one such inquiry was made in Bandipur (MY 68 Oct. 7). Most of the accounts of dhole hunting go to show that they follow fast-running prey, usually much larger than themselves, relentlessly by ground scent, tiring their quarry out in the course of a long run and then, having practically run it to a standstill, tear it down piecemeal. No doubt they do hunt in this manner, where the ground favours such hunting, but more often the run is short, only about half-a-mile or so, and the quarry is in plain view all the time. I have observed two such killings, and one of them is mentioned in the field notes (TN 63 Sep. 30). In this instance, three or four of the pack came out to the scene of the kill in advance, before the rest of the pack stampeded a large herd of chital, and drove a section of the herd across a hollow on to comparatively open ground, the outlying sentries preventing the deer from escaping to bush and tree forest beyond. Having cut off one animal (a young stag with antlers just shed) the dhole concentrated on it (though one of them also chased a hind, on its own, the hind escaping), taking advantage of its curved line of flight to get near it by short-cuts. Then one of them launched an all-out attack, a frenzied, flat-out scurry for the bite, with its effort punctuated by its rasping intakes of breath ; when it failed, it fell back and at once the attack was taken up by another dhole. There is no attempt to pull down the quarry in such attacks, but only to snatch at it, the

momentum of the much heavier prey serving no less than the jaw-power of the dhole to tear out a chunk of flesh and hide. A big stag at bay, with its back so protected by some natural feature that an attack from the rear is not possible, may probably be able to fend off the attackers with its antlers: in such a case, the dhole give up the hunt, or much more usually just surround the prey and wait, and when the tension of the situation causes the deer to break away and attempt escape by flight, it is once more exposed to attack.

Dunbar Brander says that dhole seldom hunt at night. This seems substantially true, for sight seems to be every bit as important to them in hunting as scent: they keep in touch with the members of the pack following the quarry by means of high, whistling whines when pursuing the prey through obscuring bush cover, and kill it only in comparatively open ground, guiding their attack by sight. However, hunts at night have been recorded and F. W. Champion has a night-photograph showing some dhole smelling the ground: they are active by night as well.

Dunbar Brander says he has never known them remove the stomach and intestines from a kill, and that kills from which these had been removed were probably the property of a leopard, misappropriated by dhole. In both the kills actually witnessed, one of a sambar hind killed right in front of my eyes in the course of a run over 100 yards (this is not recorded in the field notes) and the other of a chital stag which I saw being chased, heard being killed, and a few minutes later saw as a half-devoured kill, the guts had been removed as also the tail, and both flung feet from the body (TN 63 Sep. 30). In his note, Burton relying on Inverarity says that the eyes are invariably consumed at once (if not torn out earlier) as soon as the kill is made. In both the instances of personal observation cited above, the eyes were untouched, though more than half the body had been eaten by the time I inspected the kill.

The vocalisations of this normally silent animal are discussed in Burton's note. Among the vocalisations I have heard are the well-known whistling whine when the dhole were pursuing prey in bush cover (MY 68 Oct. 14; TN 69 Oct. 4), evidently sounded by the animals nearest the quarry as a guide to the rest of the pack, a short, interrogative bark and a loud, unearthly cackling which served to reassemble scattered dhole (TN 63 Sep. 30). Dhole jump high to scan the surroundings, and also go up elevations to peer over the crest (MY 68 Oct. 22 : MP 69 Mar. 14).

Burton mentions the inability of a dhole to spot him, sitting in a machan above it, from his sounding a whistle and blowing on a signal horn, and from this says that the dhole (and some other animals) are not quick in spotting things well above the level of their normal preoccupation with the ground. My experience has been quite otherwise. Few animals are quicker at pinpointing even slight sounds even from a treetop seat (MY 69 Oct. 21).

Above : TAMIL NADU 1963 : MUDUMALAI SA. : Masinagudi : September 19 — a.m. : Elephants feeding on an *Albizzia odoratissima* — TN. 27 ; *Below :* TAMIL NADU 1963 : MUDUMALAI SA. : Masinagudi : September 19 — a.m. : The cow that followed me by scent like a bloodhound — TN. 28.

(*Photos : M. Krishnan*)

Above : TAMIL NADU 1963 : MUDUMALAI SA. : Masinagudi : September 20 — near noon : Electricity comes to Elephant Country — TN. 29 ; *Below :* TAMIL NADU 1964 : MUDUMALAI SA. : Theppakkadu : March 25 — a.m. : Tusker demonstrating by goring a bamboo clump — TN. 33.

(*Photos : M. Krishnan*)

Many observers have recorded the indifference of deer and other prey species to the sight of dhole when the latter are not hunting : among them R. G. Burton (SPORT AND WILD LIFE IN THE DECCAN) and Dunbar Brander—see also MP 69 Mar. 14. E. R. C. Davidar (*JBNHS* **67** (1) : 102-103) records seeing two sambar stags walking towards and dispersing a pack of resting dhole.

The tendency of these animals to kill near the water has been noticed by a number of observers, and a few theoretical explanations have been provided. One chital killed at Theppakkadu in 1970 was said to have been actually brought to the water by the dhole, after having been killed higher up the bank of a river (TN 70 Oct. 5).

No satisfactory explanation is available for the sudden increase in the numbers of dhole in a forest area, usually followed by a no less sudden decline, or even disappearance from the area. It has been suggested that the increase follows a year of plenty, when the prey has been abundant and breeding prolific, and the decrease is caused by epidemics—it is known that dhole succumb in numbers to epidemic infections (MY 69 Oct. 24). That does not seem to adequately explain the phenomenon. The truth seems to be that dhole, while usually found in certain areas which suit them (such as Masinagudi and Bandipur), are much given to wandering, and travel far in search of feeding grounds when prey has declined in the haunts in which they were originally. It might still be found that there is a hard core of truth to Kipling's ' Red Dog '.

In the Masinagudi area of the Mudumalai Sanctuary, the role of the dhole as a predator helping in maintaining the balance of nature can be seen. Long known for its elephants and chital, in recent years the wild life of the area has been widely affected by the setting up of the hydel project at Moyar and the development of Masinagudi and surroundings from an obscure rural hamlet to a place with a sizeable population and widespread agricultural activities. Chital and pig, it seems likely, would have overrun the place but for the salutary influence exercised on them by the dhole, which keep them in check not so much by killing them in numbers as by periodically scattering and harrying them, thereby contributing in a small but significant manner to curbing their breeding.

THE SLOTH BEAR

Melursus ursinus (Shaw)

(Summary of field notes : Observation records : 5.
Footprints and claw-marks : 3.
Locations : Tamil Nadu—Mudumalai Sa. : Maharashtra—Taroba N.P.
Photograph : TN 9.)

During the survey period, although much time was spent in the hill forests where bears could be expected and were formerly common, I

saw only 5 bears and the footprints of a few more. Bears are still to be found in certain localities, as around some forest-side sugarcane growing areas in Mysore, and it is true that no special attempt was made to see them by visiting such areas. However, the meagreness of the sight records in the field notes only confirms the impression that had been growing upon me prior to 1959, that in most forests where bears were once common they now survive only in place names such as Bear Shola and Karadi Kolla, or are so reduced in numbers as to be rare. No bears were seen in the course of many night drives, except for one fleeting glimpse of a bear near Pandrapauni village in the Taroba N.P. (MR 68 Nov. 25). Collateral evidence of this decline is provided by the fact that in South India the itinerant man-with-the-performing-bear, once so common, is almost as rare as the bear itself now, though his fellow entertainers are still to be seen in the countryside, such as snake charmers and jugglers.

Size : Morphological characters

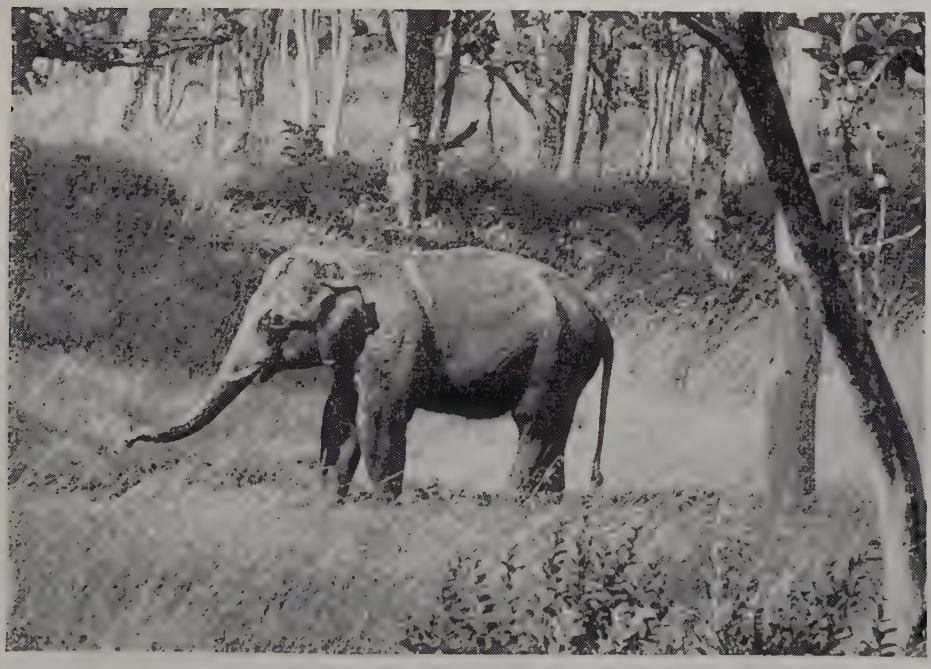
The Sloth Bear, the only bear of the peninsula, is so different from other bears that it has been assigned to a genus all its own. The long, strong white claws, the ample lips, and harsh, shaggy coat are characteristic. Height varied from 2 to $2\frac{3}{4}$ feet, and weight from 140 to 320 lb. ; in the adult, the male is larger than the female.

Distribution

Textbook accounts of distribution are now obsolete. This bear is no longer to be found in many forests where it was known even 25 years ago.

Habits : Behaviour

This bear is an expert climber, as much at home up a tree as on the ground. The fare is varied, and it is truly omnivorous ; jungle fruits such as the jamun, the ber, the bael, species of *Grewia*, species of *Diospyros*, *Cassia fistula*, the flowers of the mohwa, honey, grubs, insects (especially termites), and the tender shoots of grasses are all eaten ; its habit of raiding sugarcane in places is known, but it is not generally known that it eats much grass (TN 59 Mar. 15). Prater says that termites constitute its staple fare, and no doubt this is largely true, but what a sloth bear eats is largely a question of season and local availability, and we have really no idea of the great variety of its diet. However, it is recognised by all naturalists that it works hard for its living. Its addiction to the sweet palm-juice in the pot of toddy-tappers has been recorded by many observers. It needs water, and is never found away from some source of drinking water.



Above : TAMIL NADU 1964 : MUDUMALAI SA. : Kargudi : September 18 — p.m. : The cow elephants (with a calf) that came for us — TN. 38 ; *Below :* TAMIL NADU 1969 : MUDUMALAI SA. : Kargudi : September 18 — 4 p.m. : Blunt-tusks of Bandipur, October 11, 1968 ? — TN. 51.

(*Photos : M. Krishnan*)

Above : TAMIL NADU 1969 : MUDUMALAI SA. : Masinagudi : September 24 — near noon : The 2 tuskers by the pool — TN. 52 ; *Below :* TAMIL NADU 1969 : MUDUMALAI SA. : Masinagudi : October 5 — p.m. : The herd approaching the road — TN. 56.

(*Photos : M. Krishnan*)

Two cubs are the rule, and the mother bear's attachment to her young is well known. Bears are long-lived, and are slow breeders. They are much more diurnal than is generally appreciated, and where undisturbed are sometimes out even during the hottest hours of the day.

THE OTTER

Lutra perspicillata (Geoffroy) ?

(Summary of field notes : Observation records : 5.
Locations : Kerala—Quilon, Periyar Sa. : Bihar—Hazaribagh N.P.
Photograph : K 1.)

Even the specific identity of the very few otters seen, fortuitously, is not certain, but most probably it was the Smooth Indian Otter. Surprisingly, an otter was seen (and otters are to be seen) in the Hazaribagh N.P. even in summer, when there is hardly any source of water : the animal seen was evidently subadult, and ran ahead of the jeep at night for nearly 100 yards (B 68 Apr. 19).

Otters enjoy no protection, except perhaps in sanctuaries (where they are seldom found), and are destroyed by fishermen where found : in one instance, a holt was blown up with dynamite, destroying the otters within (K 59 June 1). Besides fish, they also feed on freshwater tortoises (K 70 Apr. 23). A party of 4 adults was seen playing in the Moyar river (TN 70 Oct. 3).

THE RATEL

Mellivora capensis (Schreber)

This is the one animal I have tried hard to see without success in the forests of peninsular India. The only time I saw it was when a big ratel ran in front of the jeep one evening, at the Hazaribagh N.P. (B 70 Feb. 4). Although it is nocturnal and therefore seldom seen, and although it is never found in numbers anywhere, I believe it does have a wide distribution in the peninsula. Many different tribals of whom I made inquiries did not know the animal at all, though drawings and photographs of it were shown to them and a description provided. The few who did know it, said it was rarely that it was seen, and then only by chance : they could not tell me anything about its fondness of honey. No doubt it is as much given to raiding honey combs in India as it is in Africa : a captive ratel I used to know had a decided sweet tooth.

THE LARGE BROWN FLYING SQUIRREL

Petaurista petaurista philippensis (Elliot)

(Summary of field notes : Observation records : 2.
Locality : Tamil Nadu—Mudumalai Sa.
Photograph : TN 23.)

There was little scope for observing this nocturnal animal in the tree forests of the Mudumalai Sanctuary, where it was twice seen by day in treetops, evidently having been bolted from its sleeping hole. Many years ago, in Yercaud in Tamil Nadu, I had exceptionally favourable opportunities for watching 4 of these squirrels which resided close by where I was staying, on three consecutive nights, when the moon was bright.

Size : Morphological characters

This is the largest of our squirrels, being slightly larger and heavier than the giant squirrel. The colour is vandyke brown, at times touched with sepia, and the parachute membrane is almost translucent in flight, when stretched between the legs on either side (Photograph TN 23). The tip of the furry tail is not covered with long hair and has a sharply constricted appearance—this is shown in the photograph. In repose and while moving about the treetop or ground, the elastic parachute is retracted against the sides and is hardly visible. Both on the ground and while going up tree boles, the squirrel has a hobbling run. The eyes are large, dark and protuberant, and evidently meant for night vision. The claws are hard and sharp. An adult, killed by tribals, weighed 3 lb.

Distribution

The tree forests of the peninsula : it seems to prefer deciduous forests to true evergreen forests.

Habits : Behaviour

This squirrel is entirely nocturnal. It spends the day within its bolt-hole in wood, a round-mouthed hole from 15 to 40 feet up the bole of a tree : from this entrance, a vertical shaft goes down the bole, ending in a comfortable chamber, in which the squirrel sleeps : it is said to sleep curled up, resting on its flat head. The presence of fresh claw-marks around the entrance-cum-exit hole in the side of the tree is a reliable token of the squirrel being at home, but it may have several bolt-holes in a locality and may occupy different sleeping trees on different days.

Perched high up a tree, it may sit high, with the tail pendent, and then looks like some dark, arboreal cat, its appearance justifying the Kannada name for it, ' flying cat '. At other times it crouches low, especially when about to take off for another tree, with its tail lifted over its back so

Above : TAMIL NADU 1970 : MUDUMALAI SA. : Theppakkadu : September 28 — p.m. : The lone bull at the Moyar — TN. 61 ; *Below :* TAMIL NADU 1970 : MUDUMALAI SA. : Theppakkadu : September 29 — p.m. : The party of elephants bathing in the Moyar — TN. 62.

(*Photos : M. Krishnan*)

Above : BIHAR 1969 : THOLKOBAD : Ligirda watch-tower : Night of February 3/4 — The bull with the brassy voice licking salt — B. 3 ; *Below :* BIHAR 1969 : THOLKOBAD : Ligirda watch-tower : Night of February 3/4 : The same bull in the previous picture with 3 subadults — B. 4.

(*Photos : M. Krishnan*)

that the tip is right above the head. It usually takes a short, hobbling run before it launches itself into the air, to gain momentum for the glide. The glide is flat in trajectory and the animal loses height with progress through the air till it is a few feet from the tree it is making for, when it rises in the air with the body parallel to the bole of the tree : this stalling brakes the momentum of the glide and enables the squirrel to land very softly on the tree. It is at this moment that tribals, hunting it, usually kill it, by means of a short, heavy club thrown at it.

Besides men, the larger forest owls prey on these squirrels.

These squirrels seem to be sociable. On emerging at night, they usually come out with a booming call, which seems to attract their fellows in the neighbourhood, and some playful gliding is indulged in in company before they settle down to feed.

Besides tree bark, fruits and nuts, leaf-buds, insects (including termites, whose crusts on the boles of trees are broken with the tip of the nose to expose the insects within), and fresh grass is eaten. I have seen this squirrel feeding on newly sprouting grass on the ground. When on the ground, it runs up a tree some 20 feet before taking off for another tree. Glides of 50 yards and a little longer are common (TN 63 Mar. 20).

I saw a large flying squirrel, along with its grown young which was almost as big as itself, bolted from the same hole many years ago by tribal hunters. Apparently the young stay with their mother till almost full grown.

THE INDIAN GIANT SQUIRREL

Ratufa indica (Erxleben)

(Summary of field notes : Observation records : 24.
Alarm call heard without squirrel being seen : 6.
Locations : Tamil Nadu—Mudumalai Sa. : Mysore—Bandipur Sa. : Orissa—Barmul, Raigoda Sa. : Madhya Pradesh—Churna.
Photograph : TN 53.)

This squirrel, fairly common in deciduous forests, was seen oftener than the field records show, during the survey period. For instance, I saw it and heard it in the forest around the river Koel, in Bihar, though this was not noted down.

Size : Morphological characters

A large, strikingly handsome squirrel seen from near, with the foreface, extremities, the tip of the tail, and the belly cream, and the head and body brilliant chestnut and black. However, it is not conspicuous in the treetops, and is oftener heard than seen. Overall length is about 3 feet, of which more than half is bushy tail. Weight of adult, around 2½ lb.

Distribution

The deciduous and semi-evergreen tree forests of the peninsula. Not found in open, dry forest.

Habits : Behaviour

This squirrel is diurnal and highly arboreal. It spends the night in big globular nests of twigs right at the top of trees, and the young are also born and nursed in such nests. It seems to have an established territory, and has several sleeping nests within this territory ; an adult male was observed chasing another in the vicinity of 3 or 4 nests late in the evening, and was probably chasing an intruder off its territory (TN 59 Mar. 12).

When leaping from treetop to treetop through the air, the body is compressed dorso-ventrally (TN 62 Apr. 5) : a leap of nearly 10 feet may be taken, but not much more than that.

A number of leaf-buds, leaves (especially fresh leaves) and twigs are eaten, among them *Anogeissus latifolia*, *Garuga pinnata*, *Lagerstroemia lanceolata* and *Grewia tiliaefolia*, (TN 62 Mar. 14 and 25, 69 Sep. 16). The fruits of teak, *Terminalia tomentosa*, and *Aegle marmelos* are eaten in season, the rasping of the squirrel's incisors on the hard shell being audible a hundred feet away. I have seen this squirrel breaking up the crust of termites on tree boles with its nose and feeding on the insects, in the same manner as other squirrels. No doubt grubs and insects are also eaten. It is fond of the nectar of the red silk-cotton as also the immature fruits of this tree (TN 66 Apr. 16). A position frequently assumed while feeding is to hang head downwards by the hind feet, using the forefeet to convey fruits or leaves to the mouth. While resting, this squirrel often relaxes on its belly across a stout twig, with the hind legs and tail hanging down on one side, and the forelimbs and head on the other.

The metallic, rattling call is used both in intraspecific communication and as an alarm : the tempo is audibly more excited when it is sounded in alarm, and both leopards and jungle cats provoke the call.

Among the predators that prey on this squirrel may be mentioned the crested hawk-eagle (TN 59 Mar. 18).

Young were seen in September in the Mudumalai Sanctuary (TN 70 Sep. 25, Oct. 1).

THE INDIAN PORCUPINE

Hystrix indica (Kerr)

(Summary of field notes : Observation records : 8.

Locations : Tamil Nadu—Mudumalai Sa. : Orissa—Raigoda Sa. : Bihar—Hazaribagh N.P., Palamau N.P. : Maharashtra—Taroba N.P.

No photograph.)

Above : BIHAR 1969 : THOLKOBAD : Ligirda watch-tower : February 4 — 7 a.m. : The lone bull gaur with the ample dewlap — B. 5 ; *Below :* BIHAR 1969 : BETLA : PALAMAU : February 21 — Night : Gaur cow — B. 15.

(*Photos : M. Krishnan*)

Above : BIHAR 1970 : BETLA : PALAMAU N. P. : February 24 — 8 a.m. : Gaur cows at Madhuchuan — B. 34 ; *Below :* BIHAR 1970 : BETLA : PALAMAU N. P. : March — 1 : about 5 p.m. : Gaur at Madhuchuan — B. 37.

(*Photos : M. Krishnan*)

Size : Morphological characters

This is said to be one of the largest of all porcupines, and the species in which the quills are best developed. A big porcupine may weigh up to 40 lb. and be nearly a yard long. The quills just above the tail are short, stout, white and very sharply pointed—these do the most damage when the porcupine gets home with its reverse-gear charge. The semi-translucent rattling quills on the tail are hollow, open at the top, and shaped like miniature wine-glasses with no bases.

Distribution

In forest areas, all over the peninsula.

Habits : Behaviour

There is a belief, both here and in Africa, that the porcupine occasionally drinks water by sucking the water retained in its hollow tail-quills : this, of course, is untrue, but it is a fact that these rattling quills are found filled with water when the animal has waded through a puddle or shallow pool. Numerous instances are on record of leopards and tigers (both very fond of porcupine flesh) getting badly stuck by the quills in attacking porcupines, even in attacks by porcupines—there are instances of such misadventures ending fatally for the predator. Dunbar Brander gives an interesting note on the animal.

Porcupines gnaw bones and antlers found in the forest floor, and gardeners in forest-side area know their partiality for the roots and shoots of many plants. They also eat fruit on occasion : a big porcupine was seen with a ripe bael fruit in its mouth (B 68 Apr. 20).

The porcupine is nocturnal and during the day it is said to sleep in deep, subterranean retreats, usually with more than one exit hole. However, it does also lie up in tall grass on occasion (TN 63 Mar. 17).

Apart from the noise made by the rattling of the hollow tail quills, when surprised the porcupine bristles out its body quills at once, with a swishing sound, suddenly growing large and indistinct : its getaway is marked by sharply angled turns, and when it has put some distance between itself and what alarms it, the quills subside suddenly, so that the animal becomes much smaller, darker and harder to see.

THE INDIAN HARE

Lepus nigricollis (Cuvier)

(Summary of field notes : Observation records : around 60.

Location : Kerala—Periyar Sa. : Tamil Nadu—Mudumalai Sa : Orissa—Badrama : Bihar—Hazaribagh N.P., Kodarma, Palamau N.P., Karkatnagar, Madhya Pradesh ; Churna, Shivpuri N.P., Bara Naya Para: Maharashtra—Taroba N.P.

Photographs : B 14, MR 3, MP 23.)

Hares, miscalled rabbits all over India, are fairly common in scrub and open forests in the peninsula.

Size : Morphological characters

The Blacknaped Hare (*L. n. nigricollis*) of the southern areas of the peninsula is larger than the Rufoustailed Hare (*L. n. ruficaudatus*) of the northern areas. 5 to 6 lb. is the weight of an adult.

Distribution

Scrub jungle around villages, open forests where there are clearings, and bush-covered plains form the chief habitats in peninsular India. Hares are commonly seen along forest roads at night.

Habits : Behaviour

Hares are mainly nocturnal. They appear to be dazed by a bright beam of light at night, such as the headlights of a motor car, and in such lighting their normally dark, somewhat protuberant eyes appear blood red, but the glare does not seem to dazzle them entirely. I have watched dozens of attempts to catch a hare crouching in the glare of spotlights and electric torches (and tried to so catch them myself) but have never known one actually caught (TN 59 Mar. 26). However, such glare, in conjunction with jingling sounds, appears to stupefy them sufficiently to be easily clubbed to death. Hare-nets are usually provided with a number of bells along their lower hem, to make them jingle when a hare rushes into them (MR 68 Nov. 18 : photograph MR 3).

During the day, hares crouch in bushes much oftener than in grass, though they may lie up in tall grass, too, where such grass in patches and belts adjoins open ground (TN 64 Sep. 27, MY 69 Oct. 16, K 70 Apr. 29).

Short grasses appear to be the main food. However, other ground plants are also eaten ; in coastal areas, *Ipomoea pes-caprae* is much eaten.

Apparently there is a break in the feeding activity between midnight and 4 a.m., when very few hares are seen in the open : they are to be seen crouching in bush cover then, often moving their jaws, as if reingesting soft-pellets.

Hares were frequently seen, usually singly, along forest roads and alongside them, during night drives. Where close bush cover was available, they crept away through the bush, but where the undershrub was more open, bounded away, sometimes making prodigious leaps.

Men, jungle cats, even leopards, jackals, wild dogs, mongooses and otters (when hunting on land) all prey on hares, and so do the larger owls and even diurnal birds of prey such as the crested hawk-eagle (TN 62 Mar. 18, 70 Sep. 24).

Above : ORISSA 1969 : USHA KOTHI SA. : January 26 — night drive : Young gaur cow — 0.1 ; *Below :* ORISSA 1969 : USHA KOTHI SA. : January 27 — night drive : Gaur bull — 0.2.

(*Photos : M. Krishnan*)

Above : M. P. 1968 : KANHA N. P. : May 4 — a.m. : Lone bull gaur — MP. 3 ; *Below* : M. P. 1968 : KANHA N. P. : May 4 — p.m. : Part of a herd of gaur — MP. 5.

(*Photos : M. Krishnan*)

THE INDIAN ELEPHANT

Elephas maximus (Linnaeus)

(Summary of field notes : Observation records : 241

Locations : Kerala—Periyar Sa. ; Tamil Nadu—Mudumalai Sa. ; Mysore—Bandipur Sa. ; Orissa—Simlipal hills ; Bihar—Palamau N.P., Singhbhum.

Outside peninsular India : West Bengal—Jaldapara Sa. ; Assam—Kaziranga & Manas Sas. ; Uttar Pradesh—East Dehra Dun, Corbett N.P.

Photographs : K2, K3, K4, K5, K6, K9, K10, K11, K13, K14, K17, K18, K21, K22, K23, K24, K25, K26, K27, K29, K30, K35, K36, K37, K38, K39, K40, K41 and K43.

TN 5, TN 6, TN 27, TN 28, TN 29, TN 33, TN 38, TN 51, TN 52, TN 56, TN 61 and TN 62.

MY 3, MY 4, MY 5, MY 7, MY 9, MY 10, MY 16, MY 17, MY 19, MY 22, MY 23 and MY 35.

B2, B12, B16, B20 and B21.

MISC 2, MISC 3, MISC 4 and MISC 5) .

Although this is the report of an ecological survey, not primarily concerned with habits, behaviour, and external morphology, and although some literature on *Elephas maximus* occurring outside peninsular India is available, it is necessary to provide some account of, the habits, behaviour and physical characters of the animal here.

Size : Morphological characters

Old Indian shikar and faunal literature exhibits a tendency surprisingly unusual in it, to be conservative in estimating the height of an elephant. The build of the animal is such that the height at the shoulder is a less reliable indication of size than with most other animals—the length and circumference of the body, the thickness of the limbs and trunk, and the relative size of the head and body vary so much with individuals that the indigenous system of classifying elephants into the *koomeriah*, *meerga* and *dwasala* types recognises that animals of all three types may be seen in the same herd. In a large herd of over 50 elephants closely observed (and photographed) there was a striking variety of build and conformation noticed (K 60 Apr. 5). When it is possible to follow a herd of elephants and watch them for some-time, it is not difficult to distinguish between individual members of the herd by their peculiarities of build.

G. P. Sanderson's much-quoted opinion, ' There is little doubt that there is not an elephant 10 feet at the shoulder in India ', was

published late in the 19th century. In the section on 'Indian Shooting' by Lt. Col. R. Heber Percy in C. Pillipps-Wolley's compilation, BIG GAME SHOOTING (London, 1895), this interesting information is provided: 'The skeleton of the well-known Arcot rogue elephant, now in the Madras Museum, measures 10 ft. 6 ins. at the shoulder. Mr. Rowland Ward considers that when alive it must have stood 10 feet 10 ins.' The mounted skeleton is still at the Government museum in Madras and still measures 10 ft. 6 in., as personally verified.

It is true that a bull elephant over 10 ft. 6 in. high or a cow over 9 feet is so exceptional that it must be left out of consideration in judging adult size, but though I myself have never seen a 10-foot elephant, to fix this as the maximum height attained by a big bull is incorrect. I measured 3 undefaced prints of the forefoot of a big bull in the Manas Sanctuary (Assam) and all 3 gave the height at the shoulder at over 10-foot 2-inch.

Incidentally, it is practically impossible to measure the height of a dead elephant: if the animal subsides on its belly, the feet are bent: if it falls on a flank, the sag of the shoulder is so great that the front leg which is uppermost (naturally, the lower leg cannot be measured) may be extended or retracted: a further complication is that this foreleg in death usually slopes down towards the ground (exceptionally, in *rigor mortis*, the foreleg may remain parallel to the ground, in the corpses of 2 elephants electrocuted by accidental contact with a low-slung high-voltage cable, the upper foreleg jutted out of the body rigidly, well off the ground—MISC 68 May 16). Furthermore, without the weight of the body on the legs, the height cannot be measured reliably: in 2 experiments camp elephants were made to recline on their flanks and keep the foreleg straight out: measurements of the distance between shoulder and sole varied within wide limits and was much in excess of the height of the animal measured when it was standing.

Even with tamed elephants, unless there are necessary facilities for accurately measuring the height when the animal is standing on level ground, measurement of the height of the shoulder may vary within wide limits. For example, the tusker Kali Prasad, stationed at Manas in February 1968, was over 10-foot as high as measured by the Range Officer and only 9-foot 9-inch as measured by me.

Provided the elephant is not malformed or exceptionally short-legged, the rule that twice the circumference of the forefoot will give the height at the shoulder within an inch or so is quite reliable with adult elephants. This is the *only* way to know the height of a wild elephant. Here, again, care and accuracy in measuring the circumference are essential for reliability. It is the clear, undefaced

Above : M. P. 1969 : KANHA N. P. : March 8 — p.m. : Gaur cow eating *Smilax* — MP. 15 ; *Below :* M. P. 1970 : KANHA N. P. : March 5 : about 9 p.m. : Lone bull gaur grazing at a roadside ditch — MP. 26.

(*Photos : M. Krishnan*)

Above : M. P. 1970 : KANHA N. P. : March 17 — about 10.30 p.m. : Lone bull gaur, sambar hinds, and a chital at the lick — MP 34 , *Below :* M. P. 1970 : KANHA N. P. : March 17 — 11.40 p.m. : The herd of gaur at the lick — MP. 35.

(*Photos : M. Krishnan*)

print of the forefoot that must be measured (as where the animal has turned sharply) and it is often said that this print must be on hard dry ground and not on moist soil, because in soft soil the foot-print tends to splay. It does not. The sole of an elephant's foot does not splay in the manner of the pug of a tiger or even the slots of a sambar on wet soil. Of course in loose sand, the imprint is not clear and the sand pushed out at the periphery leads to errors, and in mire (when the foot is pulled out of the mire at each step) there is never a clean imprint, but it is on moist earth, as on the edges of paddy fields or on bare ground after a rain, that the clearest imprints will be found. I have measured the forefoot print of the same elephant on such moist ground and also on firm ground a few yards away, and it was the print on hard dry ground that gave a circumference greater by an inch: this is because with slightly yielding soil it is not only the cushioned sole of the animal that gives beneath its great weight. The method used by me is to lay a thin, non-stretchable cord, inch by inch, along the inner line marking the circumference, with no sag in the cord: small sharp slivers of wood driven vertically into the periphery of the footprint help in this. The total length of the cord marking the circumference, is then measured. With care this method gives unvarying measurements. The diameter should not be measured for two reasons: first, the forefoot imprint of the elephant is not perfectly circular and therefore the circumference cannot be calculated by multiplying the diameter by $3\frac{1}{7}$; second, even small errors become material in such a calculation for by the time the height of the elephant is computed the diameter, and therefore the error, has been multiplied $6\frac{2}{7}$ times.

As already said, height is only one dimension in assessing size in an elephant. The length of the body varies considerably, especially in big bulls, as also its thickness. A massive bull fully 6 inches shorter than a leggy, thin animal may easily defeat the latter in a fight.

Length of tusks, in adult bulls, especially in old bulls, convey no idea whatever of size. The biggest tusks are carried by bulls whose tusks slope down to the ground, and these are generally thin. Nor does the mere thickness of the tusks reflect size or power, though an animal with horizontally carried thick tusks, especially when these project about 3 feet from the gums and are evenly curved, is usually stout, long-barrelled and powerful (photographs K2, K5 and K6); very long tusks, such as the 'record tusks' cited in the literature on elephants, are no indication of the bull carrying them being of exceptional size: on the contrary, such animals are usually only of average size. Such tusks are a constant embarrassment to their owner, hindering free movement (especially of the head and trunk)

and being a serious handicap in intraspecific fights, sometimes even in feeding. Thin, sharp-pointed, curved tusks are murderous weapons in intraspecific combats (photograph MISC 2, TN 61).

Mucknas may be found all over the range of the elephant in India and are not regional features; for instance they occur in Kerala, Tamil Nadu, Mysore, Orissa, Bihar, West Bengal and Assam. However, they are commoner in Assam and Bihar than in the southern States of India (TN 59 Mar. 5, 66 Apr. 5; MISC 68 Feb. 10; B 69 Feb. 19, 23). Tuskers have one or both tusks frequently broken accidentally or in intraspecific combats (B 68 Apr. 24—photograph B2; MY 68 Oct. 9). Sometimes an entire tusk may be lost, usually in a fight, and then the bull has only one tusk visible and is termed a 'Ganesha' (TN 63 Sep. 20, 70 Sep. 23). The camp elephant Caesar which was stationed at the Mudumalai Sanctuary for many years (till his death) had a tusk wrenched away in an engagement with a wild tusker. Cows, even when adult or old, frequently carry short tusks, projecting a few inches from the lips—these are called 'scrivelloes' in the ivory trade in India. There seems to be no regional bias to the possession of tushes by cows, and it is much commoner than is generally realised (K 70 Apr. 23).

Weight is a much more reliable indication of size in an elephant than measurements, but naturally it is very seldom possible to weigh such a huge beast and there are few reliable records. The weight of tamed elephants is no guide, for it is seldom that an elephant in captivity attains the mass and musculature of wild elephants. A very big bull may probably weigh between 4 and 5 tons. The height of a newborn calf varies from about 30 inches to 36 inches and its weight is around 200 lb.

The colour of an adult elephant is largely a question of the colour of its skin, for when full-grown the hair on the body is too sparse to influence colour. Some animals have a lighter coloured skin and some much darker skin: in the lighter grey animals there is often a pink tinge to the grey. However the colour of a wild elephant is exceedingly difficult to judge, because the colour of the animal is so often that of the earth it has been throwing over itself—even a bright red elephant may be seen (K 70 May 5). Fresh from a bath, before they have dusted themselves with earth or thrown mire over themselves, elephants appear a gleaming black, and the lighter colour of an animal in the herd is then easily noticed. Some animals are definitely and noticeably light grey in colour (photograph TN 29; K 70 Apr. 22—photograph K11).

Calves up to the first 6 months of their lives may be covered with brown hair, not in a regular coat but in a loose tomentum. The colour of this hair may be quite light at times, a warm, yellowish grey, and

Above : M. P. 1970 : KANHA N. P. : March 20 — about 10.30 p.m. : Gaur at Sravantal lick. Note horizontal horns of the small bull in the foreground — MP. 37 ; *Below :* M. P. 1970 : KANHA N. P. : March 20 — about 10.40 p.m. : The bull shown in the previous picture calling — MP. 38.

(*Photos : M. Krishnan*)

Above : TAMIL NADU 1959 : MUDUMALAI SA. : Kargudi : March 9 — p.m. : Lone bull gaur lying up in sparse grass — TN. 1; *Below :* TAMIL NADU 1959 : MUDUMALAI SA. : Kargudi : March 16 — a.m. : The lone bull gaur in c. 2 — TN. 3.

(*Photos : M. Krishnan*)

Above : TAMIL NADU 1959 : MUDUMALAI SA. : Kargudi : March 16 — p.m. : The herd-bull that covered the retreat of the herd — TN. 4 ; *Below :* TAMIL NADU 1959 : MUDUMALAI SA. : Kargudi : March 31 — p.m. : The big cow suckling her grown calf — TN. 7.

(*Photos : M. Krishnan*)

Above : TAMIL NADU 1962 : MUDUMALAI SA. : Kargudi : March 18 — p.m. : Old back-going lone bull gaur — TN. 10 ; *Below :* TAMIL NADU 1962 : MUDUMALAI SA. : Kargudi : March 19 — p.m. : Gaur herd scenting rain — TN. 11.

(*Photos : M. Krishnan*)

may give the calf a light-coloured appearance. However this hair is not retained and such calves usually grow up into dark grey animals. The reports of 'white elephants' heard occasionally are based on people seeing such calves (TN 70 Oct. 5). No authentic white elephant (i.e. a notably light-skinned animal, a creamy-grey in colour with some pink in places) has been recorded within the peninsula.

In many adults, especially in old bulls, there may be much light pink speckling on the face, trunk and ears: the tip of the trunk is usually entirely pink in such animals (K 60 Apr. 10—photograph K6; K 70 May 6—photograph K 29, K 30). Sometimes a lacing of light pink may form a conspicuous border to the lower edge of the ears (photograph K 5: K 70 Apr. 22—photograph K 10).

Distribution

Prater gives the distribution as 'the forest-clad portions of India, Ceylon, Burma' and nearby countries. In Peninsular India, broadly speaking, the elephant is absent from Andhra Pradesh, Maharashtra and Madhya Pradesh, though these States hold many forests, especially hill-forests of the kind that elephants favour. There are wild elephants in Kerala, Mysore, the areas of Tamil Nadu adjacent to these 2 States, the interior hill-forests of Orissa, and parts of Bihar. In these States, elephants occur in broad belts of montane and submontane forests which have territorial and floristic continuity though politically they may be divided: for example, in the South elephants are found along the Western Ghats and associated hills and foothill forests.

Formerly, about 1000 years ago, there were extensive plains forests in the southern parts of the peninsula and elephants were found in such forests as well. The invasion of these areas by men and their conversion to human uses have driven away the elephants from the plains in many such places. To comprehend the changes in the distribution of elephants and other large forest-living animals (like gaur), which are gregarious and free-ranging, it is not enough to take note only of the physical changes that have overtaken their known former homes and the causes that have led to their local extinction in places: such animals are unable to stand the disturbance of frequent human intrusions into their haunts, and therefore leave them if the disturbance is sustained. Place-names such as Anamalais and Kunjaramalai testify to the elephant's love of steep, forested hills.

Habits: Behaviour

Much of the daily activities of elephants centre around the two main features of their life: they need quantities of fodder (estimated at about 500 lb. of green fodder per adult) to sustain their great bodies, and half their timeis spent in feeding, and they are highly gregarious

and reassemble periodically after getting split up in the course of their search for food.

Although the largest and most massive of land animals, their peculiar build and anatomy enable them to ascend steep slopes, and they are remarkably expert at climbing hills (K 70 Apr. 20). There are few hills in the south whose tops are not marked by regular, well-defined elephant-walks: these are not just the tracks of a herd that has recently passed that way, but the well-tamped paths used and re-used by a succession of elephants: these paths always follow the easiest and safest gradients, and an expert engineer planning the best routes up and down a hill cannot do better than follow these elephant-paths. It is noteworthy that at times such paths follow the very edges of hilltops, with a sheer fall of a hundred feet or more to one side—elephants are exceptionally sure-footed and apparently never suffer from vertigo.

It is said that the fastest pace of an elephant, as when charging, is a fast walk or shuffle and that the animal cannot run. Even G. P. Sanderson, whose knowledge of elephants was extensive, deep and authentic, and whose authority still sustains many passages in recent books (for example, Ivan T. Sanderson's THE DYNASTY OF ABU) has fallen into the error of supposing that elephants cannot run: he says, 'the only pace of the elephant is the walk, capable of being increased to a fast shuffle ..... it can neither trot, canter nor gallop'. In the latter half of this statement he is perfectly correct—an elephant cannot trot, canter or gallop for the same reason that a man, when running naturally, does not trot, canter or gallop. The anatomy of the elephant is peculiar in that it has no hock as other quadrupeds have, but a true knee, like the human knee, that bends back. Therefore the elephant runs without leaping into the air, but it has two paces definitely, the walk and the run (TN 63 Mar. 24).

A consequence of their great bodily bulk is that they are virtually unsinkable, but they do not ride high in the water. They swim almost submerged, or just below the water, and the advantage of this when the surface currents are strong is obvious. (K 59 May 19, 70 Apr. 22&23—photographs K 13, K 17). G. P. Sanderson records that a batch of 79 tame elephants he despatched across the tidal creeks of the Ganges were in the water for six hours without touching bottom in one swim, and that in the course of this and three other long swims not one was lost. He rightly observes that 'full-grown elephants swim perhaps better than any other land animals'. The very young calves are at times reluctant to take to the water and are pushed in by their mothers or 'aunts' (K 59 May 19). In the water, young calves are helped by the support and guidance of the trunks of their mothers. G. P. Sanderson observes that older calves sometimes scramble on to the shoulders of their mothers during a long swim, holding on with their legs: I too

Above : TAMIL NADU 1962 : MUDUMALAI SA. : Kargudi : March 23 — a.m. : Lone bull gaur in the reeds — TN. 13 ; *Below :* TAMIL NADU 1962 : MUDUMALAI SA. : Kargudi : March 24 — p.m. : Gaur herd-bull and calf — TN. 15.

(*Photos : M. Krishnan*)

Above : TAMIL NADU 1962 : MUDUMALAI SA. : Kargudi : March 26 — a.m. : Old lone bull — TN. 16 ; *Below :* TAMIL NADU 1962 : MUDUMALAI SA. : Theppakkadu : September 17 — past 11 a.m. : The gaur herd lying down — TN. 18.

(*Photos : M. Krishnan*)

have observed this. In crossing a broad, swift-running river they choose both the point of entry along a path sloping gently down the bank into the water and the point at which they clamber ashore on the bank across the water (K 70 April 22 & 29—photographs K 13, K 14, K 18)—they have regular paths for getting into the water and out of it, even into and out of a small forest pool (MY 68 Oct. 9).

Elephants bathe in forest pools and rivers entering the water carefully, fanning out, and then rolling over in the water, frequently submerging themselves (K 60 Apr. 10, 11 and 17 ; MY 68 Oct. 9, 25 and 26, 69 Oct. 10 ; TN 69 Sep. 19, 70 Sep. 28 and 29 ; B 69 Feb. 26—photographs MY 3, MY 4, MY 5, MY 16, MY 17 and MY 22 ; TN 61 and TN 62 ; B 21). They are not found in places where there is no source of drinking water, for they drink every day though they may not bathe every day. Baths are also indulged in during the rainy season, even when it is raining. A small water-hole may suffice to provide drinking water (TN 59 Mar. 30—photograph TN 6). They drink by sucking water up their trunk and then squirting it down their throats. The process seems reversible in a small measure. It is well known that, when feeling hot, an elephant will insert the tip of its trunk into its mouth, bring out some fluid and spray it all over itself. This fluid is not water from the elephant's stomach, as it is said to be : it is not acid and does not turn blue litmus red. It is probably saliva.

Elephants draw muddy water up their trunks and squirt it over themselves, muddying the water with a forefoot for this purpose if it is too watery (K 60 Apr. 4). Water is also squirted in a shower over the back and head, and directed in squirts at the belly and head—an elephant feeling hot, cools itself in this manner. Where semi-solid mire is freely available, as at drying pools, it is taken up in lumps in the crook of the tip of the trunk and flung over the back, head and flanks (MY 68 Oct. 11 ; TN 69 Sep. 23).

A regular wallow is also indulged in : this may be when it is dry and hot, as in summer, or when it is cool, as on an overcast day in September or October (TN 59 Mar. 30, 69 Sep. 23 ; MY 68 Oct. 6, 14 and 18—photographs TN 5 : MY 9).

Dust-baths are usually taken soon after climbing ashore from water, the dust being drawn up the trunk and blown over the head and back (K 60 Apr. 3, K 70 Apr. 22 ; TN 63 Sep. 19—photograph K 10). Dust is also sprayed over wounds to cover them (K 59 May 20). Earth, and salt-earth, is kicked up by the forefoot, and eaten (MY 68 Oct. 26 ; K 70 Apr. 22 & 30 ; MY 68 Oct. 25—photograph K 21). There appears to be a tendency among gravid cows to eat earth.

Apparently all this dusting and mud-bathing and mire-smearing serves to relieve cutaneous irritation or to provide some cutaneous gratification : the way elephants revel in baths, dust-baths, wallows

and mud-slinging does suggest such a purpose. Calves under six months do not indulge in dust-baths or squirt mire over themselves because by that age they have not acquired sufficient skill with their trunk to put that most versatile organ to such uses: however, they wallow in the wet mud and in muddy shallow water.

Elephants also rub themselves, both when their bodies are covered with wet mud and when their skins are dry and clean, against the boles of trees. For this purpose a thick tree is chosen, often with a slight lean from the perpendicular, and they rub themselves against the bole on the side on which the bole leans towards the ground: such rubbing trees, covered with mud from about 3 feet to 9 feet up their boles, are often to be seen in the neighbourhood of forest pools (MY 69 Oct. 16; K 70 May 9).

One big bull chose and detached a dry twig while having a mire bath, and then scratched himself over the flanks and back with the twig held in his trunk (K 60 Apr. 4). Another bull with maggot-infested gunshot wounds rubbed himself against a venteak bole to detach the maggots from his wound (TN 59 Mar. 21).

In feeding, while the trunk is used to detach and convey food to the mouth, the forefeet are also used as adventitious aids, to crush and break up large fruits and small branches or bamboo culms, and to dust grass against. Watching elephants feed, one is impresssed by the care with which they select and prepare each mouthful for ingestion: they are choosy feeders.

Fodder naturally varies with locality and season, and what follows is merely indicative of the many kinds of plant food they eat. They are entirely vegetarian, and while hard stems and twigs are also eaten, the bulk of their food consists of foliage and soft plant parts, or succulent herbs.

Many kinds of tall grasses (all those appropriately and loosely termed 'elephant grass') are eaten, as also some short grasses and purely herbaceous plants. Among the grasses commonly eaten may be mentioned *Saccharum spontaneum*, *Ischaemum pilosum*, species of *Panicum*, *Sorghum* and *Themeda*, *Apluda mutica*, *Arundinella holcoides*, *Eragrostris gangetica*, *Hackelochloa granularis*, and *Paspalum scrobiculatum*.

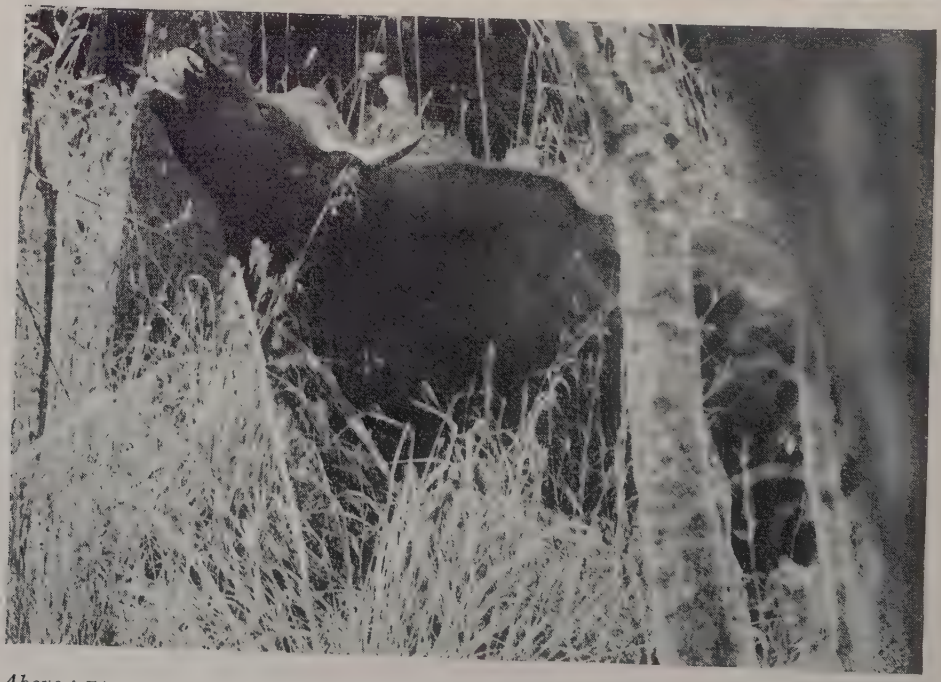
Some sedges, and some plants of the Zingiberaceae such as *Costus speciosus* and *Alpinia* spp., are also commonly eaten.

All these grasses and succulents are torn out in a sheaf or bunch with the trunk, dusted vigorously, and placed crosswise in the mouth. This is a highly skilled operation to which we find no parallel in the feeding habits of other herbivores.

The sheaf is neatly packed before it is pulled out (the grasses usually by their roots): it is then dusted on the bent and raised wrist

Above : TAMIL NADU 1962 : MUDUMALAI SA. : Theppakkadu : September 17 — noon : The herd with the big brown cows — TN. 19 ; *Below :* TAMIL NADU 1962 : MUDUMALAI SA. : Theppakkadu : September 17 — p.m. : part of the composite herd of 40 gaur showing 2 herd-bulls together — TN. 20.

(*Photos : M. Krishnan*)



Above : TAMIL NADU 1963 : MUDUMALAI SA. : Kargudi : March 17 — p.m. : Gaur cow with newborn calf — TN. 22 ; *Below :* TAMIL NADU 1963 ; MUDUMALAI SA. : Kargudi : March 25 — a.m. : Gaur cow eating nelli — TN. 24.

(*Photos : M. Krishnan*)

by being slapped sharply against it with a twirl of the trunk, or, especially when the bunch of fodder consists of short grasses with stolons or sedges, the trunk is formed into a double twist near its end and then violently untwisted in the air: this move generates considerable centrifugal force and the adherent mud and debris is sent flying away from the plant. When feeding in thick cover, when what is held in the trunk cannot be easily dusted against the foreleg, the trunk is raised high and the fodder swiftly twirled aloft to clean it. No doubt, in addition to clinging mud and dust and debris, the sheaf is freed of insects, snails and the like by these manoeuvres (TN 63 Sep. 19; K 70 May 6—photograph K 29—other observation notes and photographs, not reproduced here, support these statements).

The sheaf of grass is placed crosswise in the mouth, with the basal root part projecting from the lips on one side and the tips of the blades on the other; then, at a bite the projecting parts of the sheaf are bitten through and allowed to fall to the ground, and the rest is masticated and swallowed. When the grass is tender, the blades are consumed, and it will be found that the rejected parts of sheaves (which mark the passage of the animal in the course of its grazing) consist largely of the basal stalks and roots; when the blades are mature and hard, but basal culms are succulent, the apical part of the sheaf is rejected and the culms (with only the roots bitten off) consumed. The placing of the sheaf in the mouth and the consumption of a part of it is a selective action and not purely mechanical (TN 62 Mar. 15, 66 Apr. 23).

Bamboos (both of the genus *Bambusa* and *Dendrocalamus*) *Ochlandra* spp., and sugarcane and standing crops in fields are among the other grasses much fancied as food. In feeding on the giant bamboo, the entire clump is not pushed down: individual culms are selected, and these are either pushed down or pulled down, and then another culm is brought down. It is not only the foliage that is eaten, but also the culm. Elephants will, on occasion, eat even dry bamboo fallen on the forest floor. Ratan cane is much fancied and eaten thorns and all (MISC 68 Feb. 4). Banana plants are pulled down, the stem split open with the forefoot, and the 'pith' eaten—a noticeable preponderance of banana fibre in the dung betrays overnight raids on plantations (TN 64 Apr. 12).

E. P. Gee told me, in 1968, that when the water hyacinth (*Eicchornia crassipes*) first invaded the bheels of Kaziranga, the elephants and other wild animals would not touch it, but in 1968 I found buffaloes and rhinos eating the exotic weed occasionally, and elephants less occasionally (MISC 68 Feb. 4: photograph MISC 3). It is known that this plant has a considerable iodine content; in fact, in an emergency

it was utilised for the commercial manufacture of iodine. How far and in what ways the sustained intake (even in small quantities) of this iodine-rich plant will influence elephants (and other animals) is a matter which needs investigation.

Among the succulents eaten should be mentioned *Pandanus* spp. and *Ardisia solanacea*, both growing in brakes along forest streams : these provide a source of water even when the streams are dry in summer (TN 66 Apr. 15).

An exotic that seems to be more freely eaten now than some 25-30 years ago is lantana (TN 63 Sep. 19; TN 64 Mar. 21; TN 66 Mar. 30; TN 70 Oct. 4).

The bark of certain trees, such as *Kydia calycina*, *Grewia tiliaefolia* and teak, is skilfully stripped and eaten ; it is not the dry bark that is eaten, but bark that is sappy, especially the bark of saplings. To strip the bark from the tree, the elephant applies the ventral aspect of the base of the trunk to the tree with a firm pressure and then jerks its head laterally ; this causes the bark to split and get detached from the wood at that part, in a strip some 4 to 6 inches wide ; the lower broken edge of the strip is then gently lifted up with the trunk till the bark is stripped as high as the trunk can go and hangs from the bole ; then this strip of bark is held lax in the trunk and given two or three preliminary oscillations and then one quick upward flick, that detaches it for another 2 or 3 feet up the trunk. After eating this, another strip of bark next to the peeled strip is similarly peeled and consumed (TN 63 Mar. 24). It was noticed that in a *Kydia calycina* almost completely stripped of bark in 1963, by summer next year new bark had covered the wood (TN 64 Apr. 14).

Many shrubs and small trees are eaten, foliage and twigs together ; among these may be mentioned *Helicteres isora*, *Grewia aspera* and other species, *Hibiscus lampas*, *Acacia concinna*, *A. intsia*, *A. ferruginea*, *A. catechu*, *Cordia myxa*, and *Zizyphus xylopyrus* (TN 63 Sep. 24, 64 Mar. 21, 66 Mar. 30, 69 Oct. 1 ; MY 69 Oct. 11—photograph MY 23). *Phoenix humilis* is much liked, the foliage and the fruits both being avidly consumed.

In the South, it is not rare to come across *Buchanania latifolia* saplings in the forests that look as if they had been pollarded : wild elephants eat the crown of this tree when it is in new leaf, to give it this appearance. *Emblica* sp. and *Ficus mysorensis* and other species, *Premna tomentosa*, *Elaeodendron glaucum*, *Albizzia odoratissima* and other species, *Diospyros* spp. and *Bauhinia racemosa* are among the trees whose foliage is regularly eaten (TN 63 Sep. 19, 64 Mar. 21, 66 Mar. 31, 69 Oct. 1 ; MY 68 Oct. 20, 69 Oct. 11).

The aerial roots of the banyan are much fancied, and regularly

Above : TAMIL NADU 1963 : MUDUMALAI SA. : Theppakkadu : September 27 — a.m. : The bull with the Roman nose and the cicatrix — TN. 30 ; *Below :* TAMIL NADU 1963 : MUDUMALAI SA. : Theppakkadu : September 27 — p.m. : Gaur bulls fighting — TN. 31.

(*Photos : M. Krishnan*)

Above : TAMIL NADU 1963 : MUDUMALAI SA. : Theppakkadu : September 27 — p.m. : Gaur cow suckling grown calf — TN. 32 ; *Below :* TAMIL NADU 1964 : MUDUMALAI SA. : Kargudi : April 8 — a.m. : The cow licking her infant calf to lure it away from Vikrama — TN. 36.

(*Photos : M. Krishnan*)

broken off at the level of the elephant's reach, as they regrow (TN 69 Oct. 1).

I have seen elephants laboriously gathering and consuming the flower heads of *Mimosa pudica* (TN 59 Mar. 21, 62 Sep. 12). Flowers do not form any significant part of their diet, but they painstakingly collect tiny morsels that they specially fancy.

A variety of forest fruits are eaten, among them *Aegle marmelos*, *Artocarpus integra* and *A. hirsuta*, *Careya arborea*, *Cordia myxa*, *Emblica* spp., *Feronia elephantum*, figs, *Pandanus* sp., and *Randia uliginosa* (TN 64 Apr. 5; B 70 Feb. 26). The grain of seeding bamboos, and the seeds of *Cycas* are eaten.

The substantial part of the food of elephants consists of grasses, sedges, other herbaceous plants, and bamboos.

Young calves subsist on their mother's milk up to the age of about 6 months, when they begin to feed on grasses and herbs. They may be suckled occasionally till they are 3 years old. A young calf is singularly clumsy with its small, undeveloped trunk, which it lays against the axilla of its mother while sucking milk (K 70 May 1—photograph K 25), and it is only as it grows up that the trunk develops and it acquires skill in the use of the organ. The breasts of a cow elephant have a slight outward lean, towards the flank, and this facilitates suckling the calf (photograph K 38).

Elephants and gaur are usually found in the same forests, and it has been said that they feed amicably together. This has not been my experience. No doubt gaur benefit by following in the wake of elephants, and consuming the bamboo and other tree foliage pulled down by the latter, but elephants do not allow gaur to feed along with them (TN 62 Apr. 10). In their feeding, they keep in a group or feed by themselves, and are quite unsociable. They do not like the company of other animals even at forest pools and drive them away, or where the water is tainted by other animals having drunk at the same pool, scrape fresh water-holes for themselves with their feet (TN 69 Sep. 23; B 69 Feb. 26).

In its period of infancy and growth to adolescence and maturity, and in its longevity, the elephant bears striking points of resemblance to the totally unrelated human being. A cow elephant may be said to be adult at 16 years of age, and is capable of breeding then, though still not full-grown, and a young bull at 20. Gain in height, and especially in substance, continues till the animal is 30: it is in its prime from 30 to 40, middle-aged from 45 to 55, and definitely aged at 60, though it may be often quite robust still. Cow elephants continue to breed till about 55 years old, and seek the society of bulls even when past 60 (TN 70 Sep. 23, 27 and Oct. 3).

In recent years, doubts have been expressed by some foreign writers on the elephant really being a long-lived animal, and it has been said that it does not live to beyond 70 years. No doubt it exceeds this classical span of three-score-and-ten on occasion, even as men do, when free and wild. Anyone who has some knowledge of wild elephants in India will appreciate how much better conditioned than tame elephants they are, and how much less subject to wear. G. P. Sanderson has argued this point ably.

The periodic occurrence of musth in adult elephants, marked by a dark, oily exudation from a temporal gland with a pore on either side (roughly midway between eye and ear) and a tender swelling of the temples and forehead, is something peculiar to elephants and its full significance is not yet known (photographs K 5, MISC 2). Little that is an original addition to what G. P. Sanderson wrote about musth a century ago is available in the literature on *Elephas maximus*. Musth does seem to have some sexual significance, though it is not, as popularly supposed, merely an expression of abundant virility. Musth afflicts old elephants as well, and some animals in musth are in very poor condition—in what follows, the manifestation and consequences of musth in tame elephants have been left out of reckoning as so many artificially-imposed conditions supervene then that it is not safe to draw any conclusions from the behaviour of tame elephants when in that condition. Almost invariably, it is an adult bull that gets into musth, but in rare cases a cow may do so. G. P. Sanderson records two instances of cows in musth, ' in newly-caught females in the prime of life, and in very full condition '. During the long period of pregnancy (one of the longest among all mammals), before a cow is far gone in calf, she does often give the impression of being, not obviously pregnant, but in very full condition. All the cow elephants I have seen in musth were probably pregnant: of the 2 observed within the survey period (B 69 Feb. 19 *et seq.*; K 70 Apr. 22—photograph K 11), one was heavily and patently pregnant, and the other was very probably pregnant, appearing to be well-fleshed and in full condition. It could be that the rare incidence of musth in cow elephants is in some way related to pregnancy.

Bulls in musth often exhibit a marked lethargy, as remarked by Sanderson; this lethargy does not manifest itself in immobility or slowness of movements, but in a marked indifference to the surroundings—a bull in musth often appears to be in a state of somnambulance, though its stride is not shortened. This, however, is not an invariable feature of musth. Some bulls in musth observed were wide-awake and even aggressive, for example a tusker in West Bengal (MISC 65 Oct. 22—photograph MISC 2), a muckna in Assam (MISC 68 Feb. 10—photograph MISC 4) and a tusker in Mysore (MY

68 Oct. 9 and 25—photograph MY 17)—the last, when first seen, was in a highly excited state. Other elephants in musth have exhibited that somnambulistic indifference to their surroundings that made it possible to approach them closely for a picture (K 60 Apr. 10—photographs K 5 & K 6 : MISC 68 May 18—photograph MISC 6 : TN 70 Sep. 27). In a party of elephants it was noticed that the cows were attentive and considerate to the tusker in musth (TN 59 Mar. 30). Bulls in musth frequently squirt water over their swollen musth glands and forehead, and apparently the lavage serves to unclog the musth pores (photograph K 6). A tusker in musth invaded the elephant camp in Kargudi (in the Mudumalai Sa.) and mated with a cow that was in season—his aggressiveness towards men was not caused by his condition, but due to his resentment of being closely watched by crowds, and shouted at (TN 64 Mar. 22, 25 & 28).

A peculiarity noticed in tuskers in musth is that they often carry tight-packed clay on their tusks, so closely adherent that even a swim in fast-flowing water does not wash it away (K 60 Apr. 10—photograph K 6). This adherent clay is acquired when the tusker gores earth banks and even the clayey bottoms of forest pools while in musth: this goring is not something done in a frenzy, but evidently indulged in to cause the free outflow of musth from the temporal glands by the pressure imposed on the swollen glands by the goring (MY 68 Oct. 25 : MISC 68 May 18). The duration, periodicity and heaviness of affliction of musth all vary with individuals, and even from one bout to another in the same individual. At times the exudation is thin and at times so profuse that it stains the entire cheek and runs down the face.

As among most herbivores, the sexual act occupies only a very short time, less than a minute (TN 64 Mar. 30–a.m.), but the love-play preceding it is elaborate: coition is usually repeated many times during three or four days the bull and cow are together—even when in a herd, the pair are seen by themselves when the cow is in season and has accepted a bull (K 60 Apr. 5). The belief held by many professional elephant men that the cow decides with which bull she will mate seems to be factually sound, although it is also true that rivalry among adult bulls may become acute when a cow is in season. In elephant camps it is not unusual for a wild bull to arrive at the camp when a tame cow gets into season, and frequently the first act of the intruding bull, even before he seeks the cow, is to attack other adult tame bulls in the camp. In the Kargudi elephant camp of the Mudumalai Sa., two adult tuskers personally known to me (Caesar and Addi) were grievously wounded by wild bulls attracted to the camp by a cow coming into season. As in most other mammals, the condition of the cow is advertised by scent, but the elephant is unique in that a cow in season actively advertises her condition. Visually flagrant signs of her being in season are not

manifested (even the mahouts know that their charges have come into season mainly by circumstantial evidence, such as the interest manifested in the cow by the bulls), but the cow bends her tail between her hind legs sharply so as to slap the abdomen with its tip, and then draws the brush at the tip firmly up, rubbing it against the vagina : the tail is then held aloft in the air and waved about, in a scent-flag (TN 64 Mar. 25).

While it is true that in most animals the male cannot mate unless the female is co-operative, the peculiar anatomy of the elephant and its courtship habits makes it absolutely necessary for the bull to have the co-operation of the cow for successful coition. Because the pre-copulatory play is gentle in the elephant, the bull cannot, by aggression or force, compel the co-operation of the cow—a situation that may arise in some other animals where there is little courtship prior to the sexual act. During this phase of courtship, the bull caresses the cow with his trunk and there are repeated gentle bodily contacts. While the bull elephant is not specially peculiar in his genital anatomy, except that the testes are not discrete in a scrotum but located within the body (a feature shared by some other animals, such as the whales and dolphins, shrews and sloths), the cow elephant has the widest perineum known among the mammals, and her vagina is situated low down, a vertical slit at the end of the abdomen ; this renders it quite necessary for the cow and the bull to be precisely aligned before copulation can be effected ; the bull lays his trunk along the cow's back from behind and manoeuvres her into position before attempting to mount her, a move dependent entirely on the willingness of the cow. During the brief period of copulation the animals move around in a quarter circle—this was noticed in two matings between wild elephants observed from far off and also in the mating between the camp elephant Suguna and a wild tusker observed and photographed from near (TN 64 Mar. 30).

The rule is one calf at a birth, but occasionally two are born. The camp elephant Tara, stationed at the Kargudi camp of the Mudumalai Sa., had twins some years ago from a mating with a wild tusker. In a gregarious animal that is unusually exclusive in its intraspecific associations, the relationship between the adults in a herd and the infants and juveniles assumes a special importance. G. P. Sanderson provides a succinct and excellent account of the extraordinary consideration for the young animals in a herd shown by the adults, but on one point he seems mistaken. He concludes that cow elephants display no special solicitude or attachment to their calves, permitting men to handle their newborn young, and that from what he has noticed during the capture of elephants in stockades, the young calves of a cow are often violently repulsed by the other cows in the herd. Tamed elephants, used to having their needs, and directions, provided by men,

Above : TAMIL NADU 1964 : MUDUMALAI SA. : Theppakkadu : September 25 — a.m. : The bull with the Roman nose and the cicatrix in the background, and in the foreground the other bull—note hump and dorsal ridge of foreground bull — TN. 39 ; *Below :* TAMIL NADU 1964 : MUDUMALAI SA. : Theppakkadu : September 28 — p.m. : The big herd-bull, near the Mysore border — TN. 40.

(*Photos : M. Krishnan*)

Above : TAMIL NADU 1966 : MUDUMALAI SA. : Kargudi : September 26 — a.m. : Lone bull gaur lying up in grass — TN. 47 ; *Below :* TAMIL NADU 1966 : MUDUMALAI SA. : Theppakkadu : October 2 — p.m. : Bull gaur calling to the herd : this was the biggest bull I have ever seen — TN. 48.

(*Photos : M. Krishnan*)

might not show any apprehension at their infants being touched by men: my experience is that the most dangerous and aggressive of all elephants is the mother elephant (or even the 'aunt') apprehensive for the welfare of her calf; a remarkable instance of this was provided by two small cows, with a calf about a year or two old (the calf of one of them) between them, which came baldheaded for the riding elephant (a tusker much bigger than them) on which I was seated along with another companion and the mahout, because the tusker had been moved inadvertently close to the calf (TN 64 Sep. 18—photograph TN 38). While it is true that cows in a herd do repulse the calves of other cows on occasion (K 70 Apr. 21), it is patently incorrect to assume that the behaviour of any animal when it is confused, and panic-stricken and cannot escape, is its normal behaviour: as several observers have pointed out (especially Williams, to whom we owe the word 'aunt') not only are cow elephants very patient with their own calves, but quite often they develop an attachment and a protective feeling towards the calves of other cows to whom they are specially attached. The camp elephant Rati at the Mudumalai Sanctuary, is known for her attachment to all young calves born in the camp. Occasionally both the mother of a calf or another cow may kick or push the youngster when it is being recalcitrant (K 70 April 21) but this is always intentional, and by and large in few animals are the young in a gregarious association treated so gently and solicitously as in elephants.

It is well-known that in a herd certain adult cows develop a deep attachment (which can only be termed 'friendship') to certain other cows. Bulls, too, keep together when foraging apart from the herd, and it is a common sight to observe two or three 'lone bulls' together. This attachment of one cow to another has been observed both in the wild and among tame elephants. Indeed, so well is this recognised that in elephant camps they are not separated from each other even when put to work (as when used for timber logging) not out of any sentimental motives but because otherwise the work suffers. During the period of the survey it was noticed that the camp elephant Rati (a fine upstanding cow in her prime) could not be used as a riding elephant at the Mudumalai Sanctuary, unless the aged Sundari was also taken along with her. Among wild elephants, the tendency of certain members of the herd to group together when the herd splits into parties for foraging may be noticed (TN 66 Apr. 21).

Some of the vocalisations of elephants are well-known, such as trumpeting, squealing, squeaking (the two terms are used to distinguish a louder sound of protest from a weaker and softer sound, usually of pleasure in elephants), roaring (usually indulged in by juvenile elephants of from one to 5 years, when separated from their mothers in the course of foraging), and a sudden metallic and at the same time

tympanic sound made by rapping the trunk sharply against the ground (the sound seems to be produced mainly by the sudden percussion of the column of air in the trunk as it is expelled) which is a sound of apprehension and interrogation—strictly speaking, not all of these sounds are vocalisations, since some are produced not in the throat but in the trunk. Other vocalisations are less well-known and may be briefly set out here. One of these is a plaintive, reiterated 'kook-kook-kook', sounded when the animal suddenly discovers something that annoys it (such as the near presence of a man—TN 66 Apr. 9): it is a sound of protest, but I have also heard it used by an exceptionally burly tusker that was demonstrating at us and covering the retreat of the herd (which we were following) evidently as some form of communication to the herd. Very young calves (under 2 months) come out with a loud, quickly-repeated bark that is very like the barking of a dog (though louder and flatter), a sound that is known to very few mahouts, for it is not uttered by calves in elephant camps: it can be heard only from the calves of wild elephants, and seems to be an expression of exhilaration (TN 66 Apr. 22, 69 Sep. 23, 70 Sep. 29, Oct. 5). Older calves do not indulge in the vocalisation.

A loud, repeated smacking, made with the lips, is commonly employed by the leading adult animals in a herd when the herd is on the move and somewhat uneasy over what lies ahead (TN 69 Oct. 5): an adult cow smelling at the rump of another adult cow was also heard coming out with this smacking sound (K 70 May 4). Frequently, when the herd is grazing in the open (never in cover), the adults converge in a close circle, with their heads facing the centre, and seem to confer together; after such a conference, the animals usually move away steadily in one direction, keeping close together and not in a loose formation as when grazing (K 70 Apr. 20): I have never been able to get sufficiently close to elephants in 'conference' to know whether or not they make any sounds then, but believe they do come out with some soft, low sounds—they certainly do indulge in tactile expressions with their trunks then. Among tame elephants, two cows may be seen standing close together, almost in a huddle, caressing each other with their trunks and coming out with throaty, hardly-audible sounds—this is especially noticeable when two cows that are attached to each other meet after a separation.

Elephants in a herd are sometimes quite noisy, and at such times they are apt to be belligerent, and specially aggressive towards human intruders (TN 63 Sep. 19 and 20). The many vocalisations of a herd are often missed when observing elephants by day (partly, no doubt, because one is then preoccupied with seeing what one can), but in the stillness of the night and when conditions are specially favourable for hearing the sounds made, as when the elephants are grouped around a

Above : TAMIL NADU 1966 : MUDUMALAI SA. : Theppakkadu : October 2 — p.m. : Close-up of the second biggest bull in the composite herd : note mass and musculature and compact build—TN. 49 ; *Below :* TAMIL NADU 1958 : MUDUMALAI SA. : September 30 : Gaur cow grazing — TN. 63.

(*Photos : M. Krishnan*)

Above : KERALA 1960 : PERIYAR SA. : April 14 — close on noon. Gaur at Aiyappan Kurukku. Note build of adult cows and light colour of young calves — K. 7 ; *Below :* KERALA 1970 : PERIYAR SA. : April 29 — p.m. : Gaur at Aiyappan Kurukku — K. 19.

(*Photos : M. Krishnan*)

sheet of water (which acts as a most efficient sounding-board), grunts, grumblings, squeals, squeaks, trumpetings, 'kook-kook-kooks' and softer and less definable sounds may all be heard (K 70 Apr. 23). A sound which elephants frequently utter when they are alone (maybe in a herd the sound is drowned by the other sounds made by the animals) is a deep, audible sigh, made by the expulsion of air through the trunk—it is the one sound made by an elephant which is otherwise keeping utterly silent, and a sound for which men in elephant jungles must always listen.

Many observers have recorded becoming aware of the presence of wild elephants by hearing their intestinal rumblings—this, of course, is purely involuntary and no sort of vocalisation, even stretching the term to its widest application. But on occasion, an elephant, while standing still, will come out with a vibrant rumbling sound, low-pitched but clearly audible from some distance, that is a sound made in the throat, though the flanks also appear to vibrate while it is made. It is a sound difficult to describe, something between a low growl and a throbbing purr. A charging elephant may come on in silence (TN 69 Sep. 20) or utter a piercing, malevolent scream (TN 64 Mar. 30).

As in other mammals, intraspecific communications and expressions of mood and intent are not limited to vocalisations. The attitude of an elephant, the way it stands and moves, and the way it holds its head, tail, ears and trunk are all expressive of its emotional state. An elephant in a rage stands very still, without swinging its trunk or flapping its ears—the ears are held flat against the neck (K 59 May 20). When the animal is at peace with the world, the trunk is swung freely and the ears are flapped from time to time; when the head is held high and movements are brisk, it is in high spirits. When undecided or perplexed, the tip of the trunk is sometimes inserted into the mouth or, in a tusker, the trunk is draped over the tusks and hangs from them. It is curious that both these ways of disposing of the trunk are repeated in sleep. K. Krishnamoorthy once observed a proscribed rogue (which he shot later) asleep on its side, with the tip of its curled up trunk reposing safely in the mouth, and in a big tusker observed by me sleeping standing, the trunk was draped over the tusks (K 70 May 6). Instinctively, elephants take good care of their trunk (a vitally important organ to them) both in repose and in action. When alarmed and on the point of bolting, the tail is thrown up and the head raised, with the ears fanned out and then folded back, an attitude that serves effectively in visual communication of the alarm to the other elephants around (photograph K 27).

The elephant's vision is said to be poor, but it seems to be much better than reputed. It is true that the animal is not good at picking out stationary human beings inconspicuously clad in dark colours—

but for this, I would not be writing this report. As against this inability (an elephant's inability to see what is right beneath it, such as a man crouching in a bush, is no doubt partly due to the bulge of its cheeks and the base of its trunk), the fact that a great many intra-specific signals are usually sensed visually must be offset. An old cow returned to the water at which a younger cow was lingering after the rest of the party had left after drinking, stood on the bank for a moment and then moved off, when the younger animal instantly followed (TN 70 Sep. 24): I have observed this mode of beckoning to a member of the herd that lags behind on a few previous occasions as well. An elephant in cover wishing to cross an open space to get to other cover beyond inspected the open ground visually and also investigated it by smelling, before crossing it (TN 66 Apr. 9). At times, when it has been apprised by smell of the near presence of a man, an elephant turns round for visual confirmation of its olfactory perception (TN 63 Sep. 19: MISC 68 Feb. 19—photograph MISC 4).

The sense of smell, of course, is paramount. Even apprehension of fodder specially fancied seems to be by smell—a near-blind riding elephant was still able to know that a tree, the foliage of which she liked, was some 15 feet to one side of the path she was following, and to alter her course to eat the foliage. The presence of men near-by is often revealed to an elephant by smell, when it instantly pinpoints the smell with the tip of its trunk—it also looks hard in that direction (MY 69 Oct. 16; K 70 May 1 and 10; TN 70 Sep. 28—photographs K 22, K 43). On two occasions, when I provoked a tusker to charge me, the animals instantly charged the moment I gave them my location definitely by walking into the wind (TN 63 Mar. 30 and 69 Sep. 20). Even the reverse of the seeking of visual confirmation of the proximity of men perceived initially through smell was observed, i.e., olfactory confirmation sought by the trunk being pointed in the direction of the men seen, when the animal could not possibly smell them, the wind blowing from it to the men (K 60 Apr. 16: MISC 65 Oct. 22; TN 70 Sep. 27—photograph MISC 2). When an airborne scent is above the level of the elephant's head, the trunk is raised high to investigate it.

Elephants are well able to follow ground-scents, like blood-hounds. A cow followed me entirely by ground-scent, with a strong wind blowing from her to me (TN 63 Sep. 19—photograph TN 28) and on two occasions wild tuskers followed the tracks of the tame elephant I was riding by ground-scent (TN 64 Apr. 10; MY 68 Oct. 21—photograph MY 10): another wild tusker was observed sedulously following a ground-scent, probably the track of a wild elephant (TN 66 Apr. 21).

G. P. Sanderson says that when there is an alarm, the big bull of a herd runs away on his own and does not cover the retreat of the herd.

This is generally true, but on occasion the bull does cover the retreat of the herd. Once, when I was following a herd along with some trackers, we were halted by a singularly burly and powerful tusker which stayed behind while the rest of the herd moved into thick tree cover, and staged a most impressive demonstration, pushing over a stout sapling and then kicking it between his legs: later, when we had been halted, he moved off in the wake of the herd. Frequently such demonstrations to intimidate and halt men take the form of pushing over trees or goring small clumps of bamboos or bushes (TN 64 Mon. 25—photograph TN 33). A cow may demonstrate at a man following her by turning round and rushing towards the intruder in a short, formal charge (K 70 Apr. 22 and 29). Sometimes an elephant, resenting the presence of a man, may graze gradually towards him at a tangent, and then turn in sharply for a charge when near enough (photograph K 30).

The elephant is one of the few mammals that, even when adult, indulges in play. When bathing in company in a forest pool, it is not only the juveniles that revel in play: even the adults bump into, push down, and roll over one another with abandon—perhaps they find the sudden lifting of their ponderous weight off their feet by the water exhilarating (K 60 Apr. 11 and 17; MY 68 Oct. 26; TN 70 Sep. 29—photographs MY 16 and 19, TN 62). On land, too, adult bulls may indulge in a long bout of play with their trunks, not in a tug-of-war so much as a pushing match, or in chasing each other (TN 63 Mar. 24, 69 Sep. 23 and 24; 68 Oct. 11—photographs TN 52 and MY 7).

It is not unusual to find two, or sometimes three, 'lone bulls' going about in close company—no doubt these are bulls from a herd staying, for the time being (which may be for 3 or 4 weeks, or a lesser period) away from the herd. In such associations the younger or smaller bull often displays a noticeably subordinate position to the big bull, and is termed his 'chela'. The most expressively overt act of such subordination is the offering of a choice twig or a sheaf of foliage, by the chela to the big bull (TN 66 Sep. 17).

Sanderson records seeing a young male calf all by itself. A 5-year-old bull calf was also seen by me, contentedly feeding by himself throughout a day—there were no other elephants around (TN 59 Apr. 1). Such solitary animals are most exceptional, and one never sees an adult cow by herself, though a cow and her grown calf were repeatedly seen grazing by themselves on a hillside, not joining the other elephants on that hill (K 70 Apr. 19, 21, May 4, 5). Only adult bulls are normally seen by themselves.

These, as Sanderson points out, are seldom 'lone bulls', but the big bulls of some herd which may be, for the time being, staying away from the herd. He doubts if there is any such thing as a true 'lone

bull' and dismisses the theory of an adult bull being driven away from the herd by a stronger bull as fancy. He is largely correct in much that he says, but while it is true that few bulls, if any, are truely solitary, there are records of bulls having been seen for years on end staying by themselves, or sometimes in close association with another bull: since such animals do not wander far as elephants in herd do in their seasonal quest of food, their movements are well known to the forest-living people of the area. The question is really not one so much of fact as of terminology. If, by the term 'lone bull' is meant an animal that never, in no circumstance whatever, associates with others of its kind, Sanderson is correct and there are no 'lone bulls'. The loneliest of them will, on occasion, seek the company of a cow in season or even associate with another bull for a brief while. However, if the term 'lone bull' is applied, much more properly, to an adult male that is solitary as a rule and does not join a herd except in a transient association, there *are* lone bulls among elephants. The tusker that killed the camp elephant Shibji in the Jaldapara Sanctuary (MISC 65 Oct. 20—photograph MISC 2) was known to have been solitary for years; similarly, the bull proscribed in the Mudumalai Sanctuary as a rogue (TN 59 Mar. 6 and 21) was long known as a solitary elephant in the sanctuary, though on occasion he was accompanied by a small mukna (TN 59 Mar. 6). A big tusker with magnificent tusks and peculiarities of build that proclaimed his identity was well known as a true lone bull in the Periyar Sanctuary for over a decade, and was never seen in the company of other elephants, though elephants are seasonally common in the area (K 59 May 20, 60 Apr. 4, 70 Apr. 19—photograph K 2). Other instances of a bull living by itself for years are known. Forest-living tribals and elephant men know the distinction between such truly solitary bulls and the bulls of herds that occasionally leave the herd to be alone for some time—they call the former 'lone bull' and the latter 'the lone bull of the herd', a contradiction in terms rendered necessary by the confusing social habits of elephants! In the field notes the term 'lone bull' has been used loosely to mean both kinds of solitary bulls, but the context will make it clear which kind was meant. True lone bulls may, on occasion, drink with a herd or stay close by a herd, or even mate with a female in a herd or in an elephant camp. Such a lone bull was seen near a herd (which included three adult tuskers) at a river, but when the animals left after drinking, the herd and the lone bull went their separate ways (TN 70 Sep. 28).

G. P. Sanderson's argument that a true lone bull is never an animal driven out of a herd but one that has chosen a solitary life of its own accord, while generally true, is not invariably so. K. Krishnamoorthy once saw, first the big tusker of a herd and later the entire herd,

chasing a lone bull that had attempted to enter a herd over a long distance. A solitary bull cannot just walk into a herd and be accepted, even if he is prepared to accord priority to a larger bull already in the herd, as a matter of course. Elephants are exclusive in their intra-specific gregariousness, and may not accept a newcomer : they may ; the truth is we do not at present know what prompts them to react differently on different occasions in this regard. Even among animals moving in a herd, there may be sharp antagonism between adult bulls. There was only one herd of elephants in the Palamau National Park in February 1969, in which there were two muknas, both in musth : the older and larger of the two muknas actively resented the presence of the smaller, and chased him away (B 69 Feb. 23—photograph B 16).

Fights between adult bulls may be to the death, though much more commonly they are only skirmishes. Usually such major fights are between solitary bulls (whether or not one or both of them are true lone bulls), and may be sustained over a period of days, with breaks for feeding and drinking. Obviously sexual rivalry is not the cause of action (to borrow a convenient legal term) and the fight is not for the favours of a cow—such fights, too, are known, as already reported. It is not always that two bulls in the same area engage in such combats : even where a measure of hostility is apparent between the two, one may avoid the fight (TN 70 Sep. 29, Oct. 3). Considering the fact that elephants are much given to wandering over a wide area (though solitary bulls are less given to such wandering) and the further fact that several parties, herds and individuals usually feed in the same area without disputing the territory (vide the entire field notes for April-May, 1970, Periyar Sanctuary), such fights do not appear to be motivated by territorial rights—at times, though, they appear to be so motivated. Probably they are fights in assertion of dominance, when the paths of two big bulls happen to cross : human analogies are not far to seek.

All solitary male elephants, whether or not true lone bulls, are usually considered dangerous and miscalled 'rogues'. Some of them are belligerent towards men, some are not. It has often been said that of no wild animal are forest-living men so afraid as of the elephant, and this is quite understandable, because of the unpredictable response of chance met elephants in forests (MY 68 Oct. 15). However, few seem to realise that the aggression of elephants towards men in areas where men have invaded elephant country is almost invariably motivated by human hostility initially, or that the shooting of elephants is something that has to be done expertly, if it has to be done at all, and that the wounding of the animals may only lead to further trouble. Almost invariably a proscribed rogue (i.e., an animal that has killed a man or a few men, and which has therefore

been proclaimed a rogue) carries gunshot wounds, probably received in the course of raiding a sugarcane plantation or other crops, which have suddenly sprung up in what used to be primeval forest. For some reason, gunshot wounds do not heal easily in elephants, though other animals recover from them. They are apt to form festering sores, usually maggot-ridden, that cause considerable pain and handicap the animal, and they persist even for years. The proscribed rogue I observed in the Mudumalai Sanctuary in March 1959 (TN 59 Mar. 21) still carried unhealed bullet wounds when he was shot by E. R. C. Davidar some 2 years later.

The impact on elephants of human invasions of their territory is of special interest and significance. Most other diurnal animals retreat from their homes before human invasions of the deep forests, or else turn into fugitive creatures of the night, hiding by day in cover because men are active in the forests then. The elephant is not entirely, or even almost entirely, diurnal in its activity, but it seems to be the only wild animal with a sufficient sense of territory (in the face of extra-specific intrusions into its old homes) and a sufficient resentment of being disturbed and harried by men, to turn consequentially hostile towards men. In forests where they are little disturbed, the normal reaction of elephants to near human presence is flight. A big herd I was following at a distance, with the wind blowing from the animals to me, turned round suddenly and came towards me (and the cover of tree forests) at their fastest pace, running helter-skelter over uneven open ground : a while later, what had alarmed them (by scent) came into view, a small boy of about 8 herding a buffalo cow. A tusker about to emerge from thorn bush turned back and retreated into the dense cover on hearing the sound of a man cutting wood with an axe (TN 64 Mar. 21). Many instances of the natural tendency of wild elephants to bolt from the near presence of men are on record. They are even able to associate cattle with men, and usually flee from cattle, unless they are sure that there are no herdsmen with the beasts (TN 64 Mar. 21, 69 Sep. 23).

Where they have been much disturbed and harried by men, their reactions to humanity undergo a change. Flight is still the commonest reaction, but they may become more assertive and indulge in demonstrations and even in attacks. An interesting response, when elephants have to cross a road in a forest and stay close to the road to drink or feed, is to pull down a few culms of giant bamboo from a roadside clump, or a sapling, across the path and constitute a road-block (TN 66 Oct. 6 ; MY 68 Oct. 9).

In assessing these responses and aggressiveness to men, it should be remembered that elephants are longlived animals with a clear topographical comprehension of their stamping grounds and that their resent-

ment of intrusions, such as man-made structures, into their territory, and their proclivity to destroy such structures is something that can even be anticipated (TN 59 Mar. 31). It is said that on occasion their hostility to men takes the form of flinging stones (by the trunk) at the intruders, a less wildly improbable response than it might seem to those not intimately familiar with elephants. Tame elephants sometimes demonstrate their dislike of being annoyed by picking up and throwing a stone at a man—this is something well known, and it is even common knowledge among men in elephant camps that some tame elephants are more prone to this action than others. I have personally experienced the resentment of my attempt to get close to a herd (in which there were young calves) by the leading cow of the herd getting on to a path above me and sweeping down stones and debris at me from above with her trunk (K 70 May 2—photograph K 26).

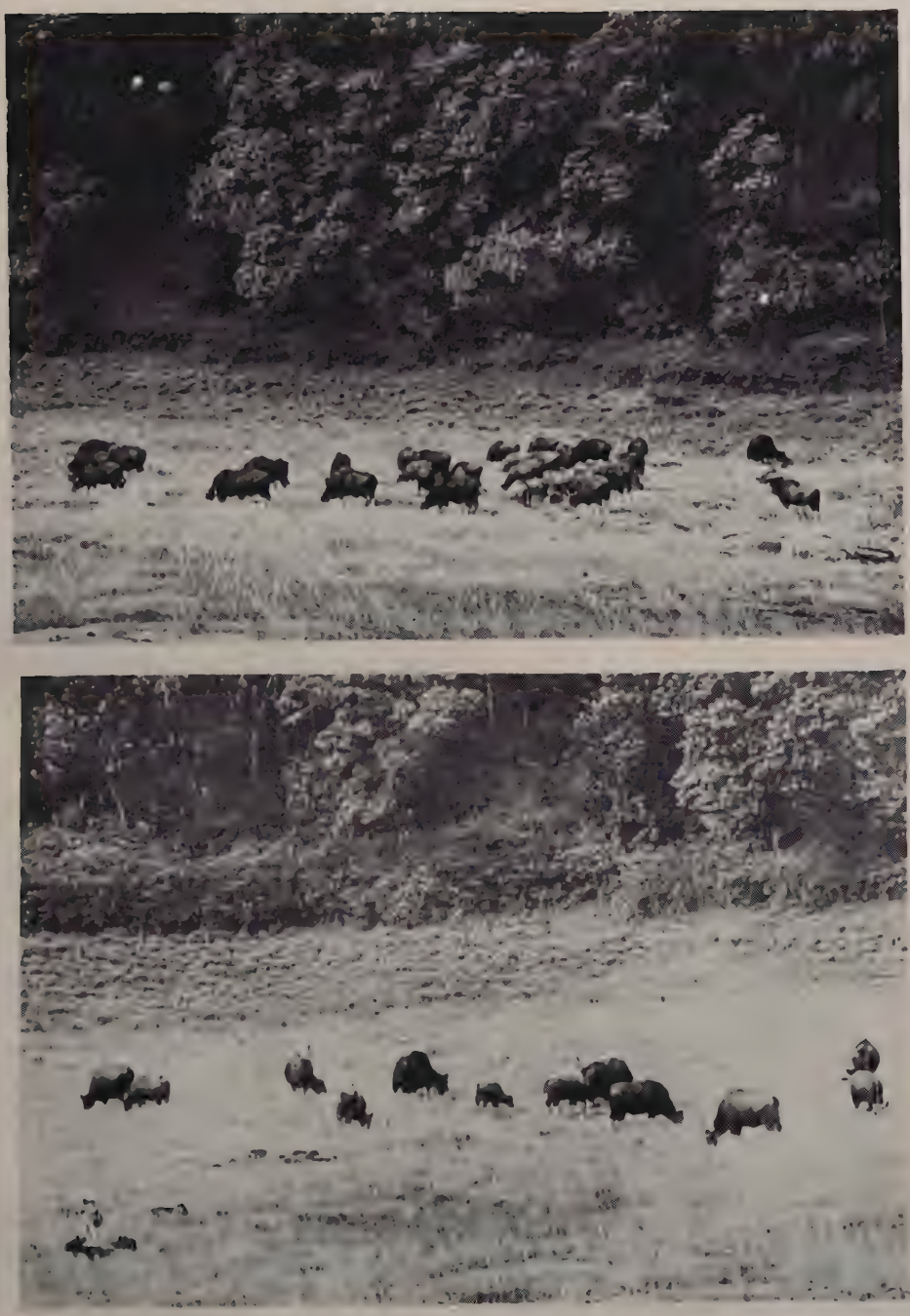
The more usual manifestation of resentment of human intrusion is a demonstration or a charge (TN 63 Sep. 19 and 20, 64 Mar. 25, 69 Sep. 20, 70 Sep. 19). However, even in an area like the Moyar block of the Mudumalai Sanctuary where what was long known as a favourite haunt of wild elephants has been invaded by a hydro-electric project, canals, clearings for the powerlines, human settlements, and agriculture and plantations, and where the human population has increased enormously and thousands of cattle are herded everyday in the forests, what is positively astonishing is not the occasional aggression of the wild elephants but their acceptance of man-made intrusions and their tolerance of humanity (photograph TN 29). Almost every year a few people are killed by elephants in and around the Mudumalai Sanctuary (the entire area, as explained in the General Account of the sanctuary in the notes for 1959, must be taken as one natural wildlife unit, though politically demarcated between three States) but these killings occur in the course of chance encounters between men and elephants inside the forests, and not at human settlements invaded by the elephants: incidentally, cows and even subadults are responsible for many of these attacks and not only the adult bulls, and as many attacks are caused by panic as by deliberate hostility.

A consequence of the invasion of elephant forests by men is that with their territory much reduced in extent and with constant disturbance from humanity, small herds moving into the area leave it in a panic (especially when seasonal conditions are unfavourable to them) and move near surrounding human settlements. Further, the raising of crops in the immediate vicinity of forests leads to crop-raiding by elephants. The methods at present in use against such crop-raiding elephants are mainly the firing of crackers to scare them off, the digging of elephant-proof ditches around the fields (a laborious

and costly method), and, of course, the use of firearms, usually inexpertly and from too far away, usually resulting in the elephants turning hostile to the men. Since elephants are most vulnerable on their perception-frontier of smell, it would be in the interests of wildlife protection in India as well as of agriculture if some liquid which is not volatile and which could be sprayed in a 20-foot wide belt, with a smell unacceptable to elephants, could be discovered or synthesised: such a scheme, naturally, involves experimental work by research chemists to ascertain which liquid would repel elephants (camp elephants) and at the same time not harm men or crops through accidental contact, but though I have repeatedly made the suggestion to those who might be able to act on it, the response to my suggestion, so far, has been entirely one of 'no-enthusiasm'.

An incidental consequence of the human occupation and invasion of elephant forests is the rumour, published from time to time in the popular press, to the effect that there is an alarming increase in the number of elephants and that this has been noticed by forest officials, who had seen calves with herds where formerly they had not seen any calves. Naturally, more elephants are seen with the deeper penetration of officials and others into the forests. As for the sudden sighting of calves, presumably there were calves even in the past, for there to be calves now, and no further comment is necessary beyond this passage from THIRTEEN YEARS AMONG THE WILD BEASTS OF INDIA by G. P. Sanderson: 'When an alarm occurs in a herd the young ones immediately vanish under their mothers, and are then seldom seen again. A herd containing a large number of calves would be supposed under these circumstances by the uninitiated to consist entirely of full-grown elephants.'

The composition of the herd has been reserved to the last intentionally. Prater says that the herd is, in the main, a family unit. This is to be construed liberally. A herd may consist of one or more families with an intermingling of unrelated individuals, and on occasion (while moving to fresh ground) two or more herds may unite into one large composite herd, marked by the presence of a number of big bulls in their prime (TN 59 Mar. 28, 66 Apr. 21, 22 and 23). In the course of daily foraging the herd (whether single or composite(usually splits into several parties which may feed at quite some distance from one another. However, normally there is no inter-mingling of two herds, or two parties belonging to different herds, even if they are close to each other or passing each other along the same path. I have observed this in many different areas, in the Periyar, Mudumalai, Bandipur and Kaziranga sanctuaries and in Corbett National Park. As already said, normally exclusiveness is a feature of elephantine herd associations. Very old animals as well as very young



Above : KERALA 1970 : PERIYAR SA. : May 7 — p.m. : The herd of gaur at Aiyappan Kurukku — K. 31 ; *Below :* KERALA 1970 : PERIYAR SA. : May 7 — p.m. : Part of the herd of gaur, showing the young calves lying up bottom left — K. 32.

(*Photos : M. Krishnan*)

Above : KERALA 1970 : PERIYAR SA. : May 7 — p.m. : Cow looking up at me — note the other 2 cows looking at her — K. 33 ; *Below :* KERALA 1970 : PERIYAR SA. : May 7 — p.m. : Close-up of a part of the herd — K. 34.

(*Photos : M. Krishnan*)

calves, and elephants of all intermediate ages, may be found in a herd. Where there are more than one adult bull in a single (not composite) herd, one may be very old and the other in his prime, or the lesser bull's acceptance of the dominance of the big bull may be evident: however, it is only rarely that two big bulls are found in a single herd: all records showing several bulls probably pertain to composite herds. The following excerpt from a description of a large herd (evidently composite) seen by Sir Victor Brooke in July 1863 in the Biligirirangan hills of Mysore is vivid, and except for its conjecture of the probable descent of many members of the herd from the patriarch, no doubt factually true: 'There were about eighty elephants in the herd. Towards the head of the procession was a noble bull, with a pair of tusks such as are rarely seen nowadays in India. Following him in direct line came a medley of elephants of lower degree—bulls, cows, and calves of every size, some of the latter frolicking with comic glee, and bundling in amongst the legs of their elders with the utmost confidence. It was truly a splendid sight, and I really believe that while it lasted neither Colonel Hamilton nor I entertained any feeling but that of intense admiration and wonder. At length the great stream was, we believed, over, and we were commencing to arrange our mode of attack, when that hove in sight which called forth an ejaculation of astonishment from each one of us. Striding thoughtfully along in the rear of the herd, many of the members of which were, doubtless, his children, and his children's children, came a mighty bull, the like of which neither my companion, after many years of jungle experience, nor the two natives who were with us, had ever seen before'. Nowadays it is seldom that one can see such a composite herd. That there were such huge herds even only 30 years ago is borne out by the testimony of those who have seen them when the elephant forests of the South were more extensive, and primeval.

THE GAUR

Bos gaurus (Smith)

(Summary of field notes : Observation records 166

Locations : Kerala—Periyar Sa.; Tamil Nadu—Mudumalai Sa.; Andhra Pradesh—Eturnagaram; Orissa—Badrama; Bihar—Tholkobad, Palamau N.P.; Madhya Pradesh—Kanha N.P.; Maharashtra—Taroba N.P.

Photographs : K 7, K 19, K 31, K 32, K 33, K 34 and K 42.
TN 1, TN 3, TN 4, TN 7, TN 10, TN 11, TN 13, TN 15, TN 16, TN 18, TN 19, TN 20, TN 22, TN 24, TN 30, TN 31, TN 32, TN 36, TN 39, TN 40, TN 47, TN 48 TN 49, and TN 63.
O 1 and O 2.
B 3, B 4, B 5, B 11, B 15, B 34 and B 37.
MP 3, MP 5, MP 15, MP 26, MP 34, MP 35, MP 37 and MP 38).

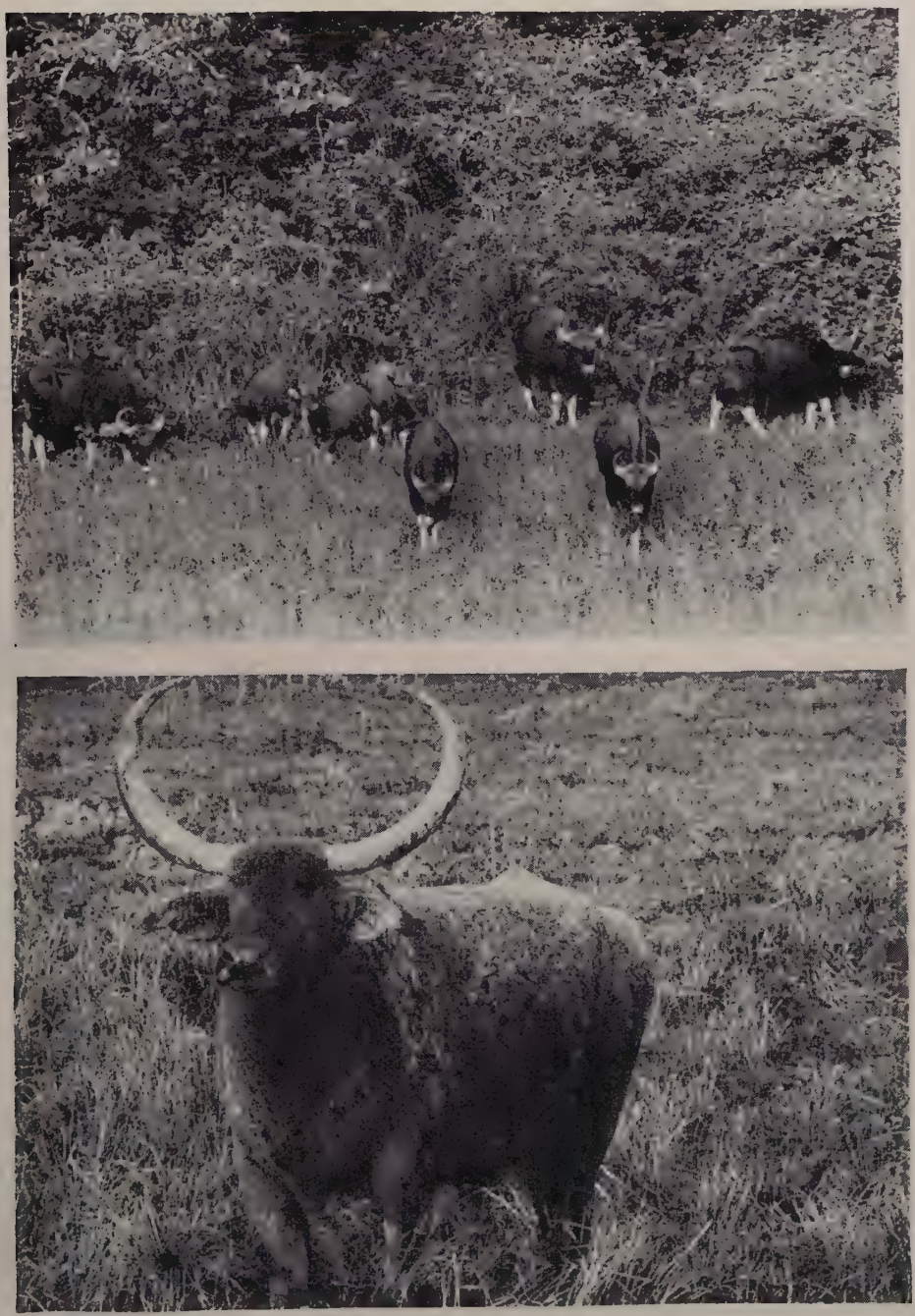
The gaur is the tallest of living oxen, and the second heaviest, the Indian wild buffalo being more massive though shorter, more powerful and much more belligerent. Gaur attain their best development within peninsular India in the lower slopes of the Western Ghats and connected hill ranges, and the literature available on this most magnificent wild ox does not suggest that elsewhere in its wide distribution over S. E. Asia it attains a superior size. Since my experience of gaur, with exceptional opportunities for close and prolonged observation, differs in some particulars from the accounts of others, some space has been devoted to this animal as well.

Size : Morphological characters

Before detailing the physical dimensions of gaur as fixed by the best authorities on the animal, it is necessary to make an important point regarding the size of large mammals in general, unappreciated so far in the literature on India's fauna. All measurements of almost all the larger mammals are only approximate, and this should be kept in mind.

In regard to one particular Indian mammal alone, the tiger (and by its generic affinity to it, the leopard), has there been searching inquiry into measurements and standardisation of the method of measurement. Because of wide differences in the length of a dead tiger as measured by different men, when the length from nose to tail-tip was taken along the curves, the system of measuring the length between pegs, which reduced human error in measurement (whether intentional or not) to negligible proportions, was insisted upon. It is significant that it is the tiger's length that is measured between pegs, for this is a dimension which is little affected by the animal being dead, it being unlikely that when alive the tiger could have stretched itself to an appreciably greater length than sportsmen measuring it between pegs do when it is dead. It is further worth noting that knowledgeable sportsmen also took other measurements, such as the girth around the forearm and the circumference of the head, when they had shot a really big tiger, the better to indicate its exceptional size, but that they seldom measured its height. Even if they had measured the height, no reliable figures would have resulted, in view of the toes in death pointing downwards, without the weight of the body on them.

How accurate is the determination of the height of a dead gaur, as measured by those on whom our faunal literature relies ? Many years ago, I tried an experiment to answer this question, measuring the height of a domesticated performing bullock (the zebu or *Bos indicus*, a species with which the gaur will interbreed, though it has contributed nothing to the evolution of the zebu) both when it was standing on level



Above : KERALA 1970 : PERIYAR SA. : May 9 — p.m. : Gaur coming out of cover — K. 42 ; *Below :* ASSAM 1968 : Mihimukh, Kaziranga Sa. : February 3 : Wild buffalo cow with the semicircular type of horn — MISC. 4-A.

(*Photos : M. Krishnan*)

ground and when it was made to lie down on a flank with its forelegs held straight out. Repeated measurements gave differing figures for the height when the animal was lying down on a side and it was found that the lift of the foreleg (that was uppermost) from the ground, the flexion of what corresponds to the fetlock in a bullock, and the convex curvature of the shoulders and hump all materially influenced accuracy in measurement: the measurement between pegs differed from the measurement with the tape held straight over the curves, and standing height was less by an inch from the least lying-down height. The measurement of the height of such a massive animal as the gaur should present even greater difficulties and will depend materially on how the animal has fallen down in death. One further point may also be mentioned here. The conversion of the measurements recorded in feet and inches into centimetres by multiplying the total in inches by 2·54 only magnifies the error by 2·54; however, such a conversion does invest what is intrinsically a rough measurement with the verisimilitude of scientific exactitude. All this is detailed at such tedious length only to make the point that such measurements as we have of the height of most wild animals are approximate, though they are probably near approximations to the truth.

A big gaur bull may stand over 6-foot high to the top of the dorsal ridge and weigh almost a ton. Prater gives the height of adult bulls on an average at about 5-foot 9-inch, and adds that adult cows are about 4 inches lesser in height. Considering the great mass of the body, the difference in height between a big cow and a bull is not readily appreciable, and in forest lighting and in the forest setting the other differences between the sexes, such as the larger dorsal ridge and fuller dewlap and the more divergent and massive horns of the bull, are not clear either, as the number of adult cows shot by sportsmen licensed to shoot bulls will testify. Schaller gives the height of the bull at 64 to 72 inches and the length at from 11 to 12 feet, and adds that the cows are 'considerably smaller', a statement that is true for the Kanha N. P. area where he made his observations.

Bulls with massive, divergent horns (photographs TN 1, TN 48) are easily distinguished as bulls by their horns, but in many adult bulls the horns are not widely divergent and not so obviously different from those of big cows TN 62 Mar. 20 and 28—photographs TN 4, TN 10, TN 15). Height *per se* is no more reliable an indication of size in gaur than in elephants: some bulls are very long in the barrel though low-to-ground in build, so much so that they can be picked out from other gaur in a herd easily by this bodily peculiarity (TN 62 Mar. 24, 66 Apr. 20).

While undoubtedly there is no case for the distinguishing of different subspecies of gaur on the basis of size and colour, there do seem to be

two main 'kinds' (a weak word, it is realised, but no better term is available) of gaur in peninsular India. Since these are often found together in different herds in the same area, and sometimes even mixed in one herd (as when a composite herd breaks up in some confusion and before it reforms), no taxonomical distinction between the two can be attempted, but it should be stated that there do appear to be two main 'kinds', leaving out the light-coloured gaur said to be found in a part of Tamil Nadu.

Regarding these two kinds, the following general statements appear to be valid. The smaller kind is distinguished by the cows being noticeably smaller, and square-built, with much black hair on the throat and generally of a darker and more sooty colour, and having smaller and straighter horns (horns not formed in a semilunar curve, but more like that of some short-horned domestic zebu): the adult bulls in the two kinds differ little, except that in the smaller kind the adult bulls appear to be invariably black when full-grown, and are of smaller relative size. The disparity in size between the sexes is most noticeable in the smaller kind and further, the young calves tend more to be of a brown-pink colour at birth than a golden fawn. Throughout the north of the peninsula, in Orissa, Bihar and Madhya Pradesh, I saw only this smaller kind: I did not have adequate opportunity to form any opinion on the gaur of Maharashtra or Andhra Pradesh, but these, too, are probably mainly of the smaller kind. In Mysore and Tamil Nadu both kinds are to be seen, and in Kerala I saw only the larger.

Many adult bulls of the smaller kind were quite small in size and appeared smaller than a full-grown cow of the larger kind—in fact, they were not much larger than the adult cows with them (MP Mar. 17 and 20—photographs MP 34, MP 37 and MP 38). Further, the tendency to somewhat disproportionately long barrels in some bulls (already detailed) was observed only in this kind. Field notes and photographs, some of the latter specially taken to display the features of the cows, provide a fuller description: TN 62 Sep. 13, 14, 15, 16, 17 and 63 Apr. 5; O 69 Jan. 19 and 26; B 68 Apr. 20, 28, 69 Feb. 3/4 and 5/6, 21, 22, 70 Feb. 24 and Mar. 1; MP 68 May 2, 3 and 4—photographs: typical cows: TN 32, O 1, B 34 and B 37, MP 37: typical bulls: B 3, B 4 and B 5: herd: TN 18 and TN 20.

The larger kind has already been described comparatively. It is sufficient to add that some of the most impressively large bulls of this larger kind are not black, but a deep vandyke brown or a very dark burnt umber in colour (TN 64 Sep. 28, 66 Oct. 2—photographs TN 40 and TN 48): some very big bulls are also black (TN 59 Mar. 9, 12, 16 and Apr. 2; K 70 May 7—photographs TN 1, K 31). Descriptions in field notes and photographs of typical cows are provided in K 60 Apr. 14, 16, K 70 Apr. 19, 20, 22, 29, May 1, 4, 6, 7 and 9: TN 62 Sep.

17, 22; TN 64 Mar. 31, Sep. 28; TN 66 Sep. 28 and Oct. 2; TN 70 Sep. 15 and 21—photographs K 7, K 31, K 32, K 33 and K 42; TN 19, TN 40, TN 48 and TN 49). Calves are usually a golden sienna in colour in their infancy.

In the Theppakkadu area of the Mudumalai Sanctuary, where composite herds can be seen in September-October, sometimes the two kinds may be seen in loose association. I am not definitely sure whether or not there is a decided tendency for the two kinds to stay apart normally, my studies into this question having been frustrated by the epidemic of rinderpest that broke out in 1968 and which resulted in my seeing no gaur at all either in the Mudumalai or in the Bandipur sanctuaries in 1968, 1969 and 1970 (except for a few small parties seen in the Mudumalai Sa. in September 1970).

Sometimes an animal from a herd of one kind does get into a herd of the other kind, as detailed in the field notes referred to, but such an association seems to be purely transient.

It is true that in between these two distinct kinds there are parties and herds intermediate in character, so that the distinction may seem idle, but there is sufficient constancy of relationship between size and colour in these two kinds, especially in the cows, to warrant such a distinction.

Distribution

Gaur have been affected even more than elephants (the two are often found in the same forests) by the dwindling of the forests and human invasion of their old haunts. Apart from this, they have been seriously affected from time to time by epidemic diseases like rinderpest and murrain through infected cattle grazed in the forests—in fact, no wild animal in India has been so profoundly influenced by infections from domestic stock as gaur. Further, the indiscriminate shooting of gaur for 'sport' (licensed and unlicensed) and their hunting by tribals (as in Bastar) has led to the decline or extinction of small local populations. For these reasons, the distribution of gaur has altered materially in places during the past 30 years, and accounts of their distribution as it obtained in the forties are no longer valid in many areas. Schaller, in his chapter on gaur in THE DEER AND THE TIGER provides an admirable account of their present distribution, but this, based almost entirely on information provided by others, is in need of amplification, as he himself realises.

Comparing the present distribution of gaur as plotted by him on a map of India with a vegetation map of the country, he says that 'the animal is largely confined to the evergreen, semi-evergreen and moist deciduous forest areas but ..... it has also penetrated the dry deciduous forests at the periphery of its range. The apparent preference

of gaur for hilly terrain may in part be due to the conversion of much of an earlier habitat in the plains into fields, whereas the hills have until recent years been left relatively undisturbed '.

The shikar literature of South India of the last century and the early part of this century, when there were still plains forests in the region, does not suggest that the preference of gaur for hilly and hill-side terrain is a consequence of human occupation of the plains forests; there is some evidence in classical Tamil (about 18 centuries old), which is quite familiar with the plains forests, to show the preference of gaur for hill-forests, but while all this is no doubt interesting it is entirely irrelevant in this report which is concerned mainly with the present, especially when the past does not disclose that gaur were ever common in the plains forests.

Gaur are not animals of the evergreen forests. In the north of the peninsula they are found today mainly in the deciduous and semi-deciduous (the latter may be termed semi-evergreen as well, considering that the word ' semi ' connotes a half, strictly construed) hill-forests and forests around such hills; in the south of the peninsula, there are no large belts of evergreen forests anywhere in the areas where gaur are to be found: pockets and patches of evergreen vegetation alternate with deciduous forests, elevation, rainfall and edaphic factors being the main influences determining the formation of such evergreen areas.

Today, in spite of the great losses caused by rinderpest in 1968, more gaur are to be found in the south of the peninsula than in the north, and in the south, their distribution follows the low-elevation hill-forests and is fairly extensive. Schaller cites my authority for the statement that there are probably 300 to 400 gaur in the Mudumalai Sanctuary. Apparently I failed to make it clear, in providing this opinion, that there is no large permanently resident population of gaur in that sanctuary and that gaur move from the area into the adjoining Mysore and Kerala areas, and from them into the Mudumalai area again. It is difficult to estimate the total number of gaur in this vast and varied stamping ground which must be one of the best areas for gaur in the world, but it is certainly far in excess of 400, many times that. Schaller provides the information that there are two isolated populations of gaur ' along the Madras-Kerala border in the Anaimalai Hills and around Periyar Lake '. There are certainly more than two isolated populations in this considerable area.

Gaur are far-ranging animals, moving in herds (and in composite herds at times, especially when shifting ground) over a considerable forest area as seasonal needs require them to. For this very reason, because they need extensive grounds, and because the forests are

Above : M.P. 1968 : KANHA N.P. : May 1 — a.m. : A string of 11 blackbuck — MP. 1 ;
Below : M.P. 1970 : KANHA N.P. : March 22 — a.m. : Trio of male blackbuck — MP. 39

(*Photos : M. Krishnan*)

Above : TAMIL NADU 1968 : PT. CALIMERE : December 16 — a.m. : Blackbuck does — TN. 50 ; *Below :* TAMIL NADU 1969 : PT. CALIMERE : December 15 — evening : Blackbuck does against screwpine — TN. 57.

(*Photos : M. Krishnan*)

now much less continuous than in the past, their distribution is discontinuous today.

Habits : Behaviour

Most of the field observation of gaur was done during the day from elephant back in various parts of the Mudumalai Sanctuary of Tamil Nadu, mainly in the Kargudi and Theppakkadu blocks of that sanctuary. In Orissa, Bihar and Madhya Pradesh gaur were seen both by day and (more commonly) by night, mainly from a jeep or hide. In observing gaur from elephant back a fairly fluid technique of approach was used, which often led to the gaur accepting the riding elephant (with the men atop) and going about their affairs as if we were not there (TN 59 Mar. 26). In this manner it was possible, moving slowly with the moving herd, to follow it for hours or even throughout the day, and observe the gaur from close quarters, though it was seldom possible to raise oneself adequately high (to sit up, for example) for taking photographs without alarming the animals: incidentally, conversation in low tones, limited to a few necessary instructions, had absolutely no effect on them, once we were right in the herd and had been accepted (TN 59 Mar. 26, 62 Sep. 14, 17, 63 Mar. 17, 26, 63 Sep. 13, 16, 25, 63 Oct. 1, 64 Sep. 22, 23, 25, 66 Sep. 28).

Dunbar Brander's statement that gaur are essentially animals of extensive forest that 'avoid man and all his works as much as possible' is profoundly true. Where they are not much disturbed by men, they are diurnal in the main, although they do feed for some time at night. In areas where their activity is mainly diurnal, they feed and are on the move till late in the morning, and then lie up for a siesta during midday. They are up again in the afternoon, and towards evening often seek a clearing: they lie up again for awhile at night, feed again, and are generally to be found lying down again by about midnight. This is a generalised composite account based on observation of gaur both by day and by night, in areas where they are not much disturbed, though the field notes refer only to daytime observations. Where they are subject to disturbance by men during the day, as in most areas in Orissa, Bihar, Madhya Pradesh and Maharashtra, as also Andhra Pradesh, they come out mainly at night, turning crepuscular and nocturnal and naturally their feeding and other activities are continued later into the night. Even so, gaur were observed to be lying up chewing the cud by about midnight (O 69 Jan. 25, 27 ; B 69 Feb. 21, 70 Feb. 24).

Apparently, gaur have changed their habits in areas within the past 50 years. Dunbar Brander writes of them as animals he has seen and

watched by day, but Schaller found them largely crepuscular and nocturnal in the same or similar area.

During the hottest part of the day, gaur generally lie down; animals in a herd choose some shady spot, and usually favour a hollow, well covered with grass, for the siesta (TN 62 Sep. 14, 17, 63 Mar. 12—photograph TN 18). Lone bulls lie up in tall grass, or at times in bushy cover (K 60 Apr. 11; TN 66 Sep. 26—photograph TN 47). I noticed in 1958 that in parts of the Mudumalai Sanctuary where lantana grows in a continuous thick belt, the gaur had tunnelled regular dormitories in the cover and slept in them by day, both small parties and solitary bulls (TN 62 Mar. 14).

Dunbar Brander gives this account of the seasonal wanderings of gaur: 'During the cold weather they frequent grass maidans on hill tops, and the bamboo and creeper-clad slopes of the hills. As the hot weather advances, shortage of water and food forces them down, and they can then be found at lower elevations, frequenting grassy glades or the banks of streams. In the rains they wander much, but during other seasons they frequent the same places at the same time year after year'.

Seasonal movements noticed in the Mudumalai Sanctuary followed the rains, the rank growth of the undershrub after the monsoons, especially the tall grasses, the desiccating heat of February-March and the withering of the grass, and the lack of foliage and shade in the deciduous tree forests. Although the perennial waters of the Moyar attracted elephants to the vicinity of the river in summer, the gaur were not drawn to the river and to the surrounding Theppakkadu and Moyar areas so much as to the interior forests of Kargudi, Mudumalai and the base of the steep hill, Markundarai Betta near Theppakkadu: comparing the elevation, there is a difference of only a few hundred feet between the flatter terrain of the riverside forests and the more hilly ground of the other areas but the ground vegetation is low in the riverside forests, whereas there are belts of all grass at Kargudi, and 'gaddes' (swampy areas), and the tree forests are generally taller and less entirely leafless in Mudumalai, where also there are swampy areas and belts of bamboo (TN 59 Mar. 12, 15*, 16, 26*, 31*, 62 Mar. 24*, 62 Apr. 7 & 9, 63 Mar. 12, 19, 63 Apr. 1*, 2, 5, 64 Mar. 16, 17, 23, 28, 31, 64 Apr. 8*, 66 Apr. 20, 21, 23). During the heat of midday, the gaur in herds generally lay down in tall grass or sought the shade of the more leafy trees along the dry and semi-dry nullahs, but even when the sun was hot they were moving through the shadeless, leafless tree forests—the references to the field notes above marked with an asterisk denote such occasions (photographs TN 7, TN 14). They found the water they needed at shallow pools and semi-dry nullahs, as at Imbarhalla, and were often found in tall grass

Above : M.P. 1969 : SHIVPURI N.P. : March 31 — 10 p.m. : Subadult nilgai bulls — MP. 34 ; *Below :* BIHAR 1970 : HAZARIBAGH N.P. : February 15 — about 3.30 p.m. : Bull nilgai — B. 30.

(*Photos : M. Krishnan*)

Above : M.P. 1968 : KANHA N.P. : May 1 — a.m. : Part of a herd of barasingha lying up. Note two 12-pointers, and the brocket lying with neck outstretched — MP. 2 ; *Below :* M.P. 1969 : KANHA N.P. : March 8 — a.m. : Part of the herd of 47 barasingha — MP. 13.

(*Photos : M. Krishnan*)

belts where the tree growth was sparse. Apparently what attracted them to these forests was the fresh tall grasses coming up and regenerating herbs, as also the new leaf of some trees.

In September-October, when the tall grass was rank and very high, and when the ground vegetation was also coarse, and the flies were specially abundant in such cover (TN 62 Sep. 12, 63 Sep. 14, 64 Oct. 6), gaur were to be seen only in the open clearings in certain parts of Kargudi (compartment 2 and from it to near Abhayaranyam) and in the Theppakkadu and Moyar areas. Near the river, then, the ground vegetation of the forests was lush and low, and gaur were sometimes seen in lantana patches, but not in tall grass belts (TN 62 Sep. 13 to 17, 22, 63 Sep. 12 to 17, 22, 25, 27 and Oct. 1, 64 Sep. 21 to 25, 28, 70 Sep. 15, 19 and 21—photographs TN 18, TN 20, TN 40). During late September and in October, gaur tend to move out of the Mudumalai sanctuary to other areas around, notably to Bandipur which is not on a lower elevation, but where the forest is more open and level and there is little tall grass, but plenty of lush short grass. It is to be noted that it is not as if there is a general exodus of the gaur from the Mudumalai sanctuary to Bandipur and other surrounding areas in these months ; some herds stay on in the Mudumalai Sanctuary, as at Masinagudi and in Kargudi.

It will be seen that these observations are diametrically opposed to what Dunbar Brander has said, but that only shows how profoundly the behaviour of the same animal can differ in different settings (Madhya Pradesh is very different from Mudumalai in its vegetation, terrain and in the extreme climatic contrasts between summer and winter there) and how risky it is to draw inferences on the general behaviour of an animal from observation of it in one particular habitat.

Gaur are given both to grazing and browsing : their main fodder is various kinds of tall and short grasses, and a number of ground herbs and small shrubs, such as *Hibiscus lampas*, *Grewia aspera* and *G. hirsuta*, *Helicteres isora*, *Butea parviflora*, *Desmodium pulchellum* and *Costus speciosus* (K 70 May 7 and 9 ; TN 59 Mar. 9 and 13, 62 Sep. 20, 63 Mar. 19, 64 Mar. 28). Coarse, robust grasses that have matured fully are not eaten—many of these develop, with maturity, a sharp, siliceous edge to the outer margins of the leaf-blades that can cut through the skin of a man's hand. They eat the tender shoots of tall grasses coming up in summer much as they eat short grass coming up after the rains, cropping them quickly and continuously in the manner of cattle, moving along as they graze with lowered heads ; but when the grass is about 18-inch high or higher, they crop it in sheaves, getting the sheaves crosswise in their mouths and raising their heads periodically to chew and swallow the mouthful (K 70 May 7 p.m., 9 p.m.—photographs K 31, K 32, K 34, and K 42 ; TN 62 Mar. 26,

TN 66 Apr. 15—photograph TN 16; MP 70 Mar. 5—photograph MP 26) photograph TN 63, although taken prior to the period of this survey, is also included as it shows the way the grass is held crosswise in the mouth very clearly.

The foliage and soft twigs of a number of tall shrubs, trees and climbers are eaten, among them *Cordia myxa*, *Grewia tiliaefolia*, *Zizyphus trinervia* and *Z. xylopyrus*, *Emblica* spp. and *Smilax zeylanica*: special mention should be made of *Ardisia solanacea* which is eaten foliage stems and all (TN 63 Mar. 19, 25; TN 64 Mar. 28; MP 69 Mar. 8—photographs TN 24 MP 15). Gaur do not spend any time nibbling delicately at small titbits like leaf buds or flowers; they are bulk feeders and crop and ingest green fodder quickly, lying down several times in the course of the day and night to chew the cud. The tongue is extruded to curl around leaves and twigs and pull them into the mouth but not to strip leaves of branches—that is done with a bite and a tug. In areas where they are not much disturbed by humanity, most of the feeding is done by day, from early in the morning to late (about 11 a.m.) and again from about 2.30 or 3 p.m. to 5.30 p.m.

Among the fruits eaten should be mentioned *Aegle marmelos*, *Cassia fistula* (TN 64 Mar. 28), *Gmelina arborea*, the fallen fruit of *Emblica* spp. and *Terminalia bellerica*. Dunbar Brander mentions that they are fond of the fruit of *Randia dumetorum*: I have never seen gaur eating this fruit, though on 4 occasions I observed a herd pass the trees in fruit, and once a few trees of *Randia uliginosa* growing on the edge of a swampy area—that is not to question the truth of his statement.

Bamboo foliage and culms, when tender, are much eaten, and both *Bambusa arundinacea* and species of *Dendrocalamus* are browsed. Gaur are frequently unable to reach up to the foliage of the giant bamboo up the culms, but when elephants have pulled down a clump, they wait till the pachyderms have left and then feed on the bounty.

As with other herbivores, salty earth is eagerly sought out and eaten—the earth is licked when hard, but when moist and friable, bitten off. Artificial salt licks at the Ligirda watch-tower in Tholkobad (Bihar) and at Sravantal in the Kanha N.P. attracted gaur at night: at Sravantal the gaur were seen in association with chital and sambar (B 69 Feb. 3/4 and 5/6—photographs B 3, B 4 and B 5; MP 70 Mar. 12, 14, 16, 17, 19, 20 and 22—photographs MP 34, MP 35, MP 37 and MP 38).

As already said, gaur do not require large sources of water to drink, though where extensive sheets of water can be approached along level ground, as at the Tarıoba and Periyar lakes, they will slake their thirst at lakes. In the hill forests and even in plains forests they drink at small streams, pools and puddles, often travelling a long

Above : M.P. 1969 : KANHA N.P. : March 8 — a.m. : The master stag of the herd in picture MP. 13 : a 12-pointer — MP. 14 ; *Below :* M.P. 1969 : KANHA N. P. : March 16 — p.m. : The 'head-up' display — MP. 19.

(*Photos : M. Krishnan*)

Above : M.P. 1969 : KANHA N.P. : March 17 — a.m. : Barasingha stag in his third year — MP. 20 ; *Below :* M.P. 1969 : KANHA N. P. : March 18 — a.m. : The barasingha stag with the right brow-tine broken — MP. 21.

(*Photos : M. Krishnan*)

distance to reach the water, grazing towards it: in the Theppakkadu area of the Mudumalai Sanctuary, for example, there are two shallow pools, barely 20 feet across, and gaur in the area always come to them to drink, so that in ascertaining whether or not there are gaur in that area an inspection of recent footprints in the soft mud around these pools is sufficient to provide a reliable clue. They do not appear to drink at any fixed time of the day or night: probably they drink very late in the evening or very early in the morning, before dawn, for I have seen fresh footprints of gaur at the Madhuchuan pool very early in the morning, and also at a few other similar pools which provided the only convenient source of water within miles. They may drink early in the morning or later, about 9 a.m. (TN 63 Mar. 29; B 69 Feb. 17), at midday or in the afternoon about 4 p.m. (TN 63 Mar. 13; B 69 Feb. 22, 70 Feb. 24 and 27) or in the evening (TN 62 Mar. 16; B 70 Mar. 1). They drink deep, drawing in the water in an almost continuous draught, and take only a minute or two to quench their thirst.

They do not appear to bathe, or to wallow in mire as sambar do. Occasionally a few animals may be seen standing in knee-deep water at a pool, but they seem to distrust deep water, and cross the Moyar (in their frequent passage from the Mudumalai Sanctuary into Bandipur and back) only along certain rock bottomed shallow fords as at Kakkanhalla.

Lone bulls do not differ from gaur in herds in their feeding and drinking habits, but in the Mudumalai Sanctuary it was observed that they often kept, for weeks or even longer, to the vicinity of a small swampy 'gaddee' or a stream, not wandering far from it to graze and no doubt the vegetation of such areas has its distinctive individuality (TN 59 Mar. 8, 12, 16, 62 Mar. 16, 23, 63 Mar. 13 and 18—photographs TN 3 and TN 13: TN 59 Mar. 9, 13, 18 and Apr. 2—photograph TN 1: TN 63 Mar. 26 and 28).

The age to which gaur probably attain becomes relevant in the context of their inhabiting the same area over a period of years. Although some cows may have a distinctive scar or other mark, or an accidental mutilation or the malformation of one or both horns, that will serve to identify them, it is the adult bulls, so marked by accident or natural peculiarity, that are more readily spotted; further, bulls with herds, or accompanying herds, tend to wander far along with the herds, and it is the confirmed lone bulls (which are frequently seen by themselves in the same area) that can be observed over a number of years, particularly where they have not been shot at or otherwise seriously disturbed by men. The last condition, however, is so rarely fulfilled that such bulls, especially those owning fine heads, frequently have their lives ended prematurely to provide trophies to hunters.

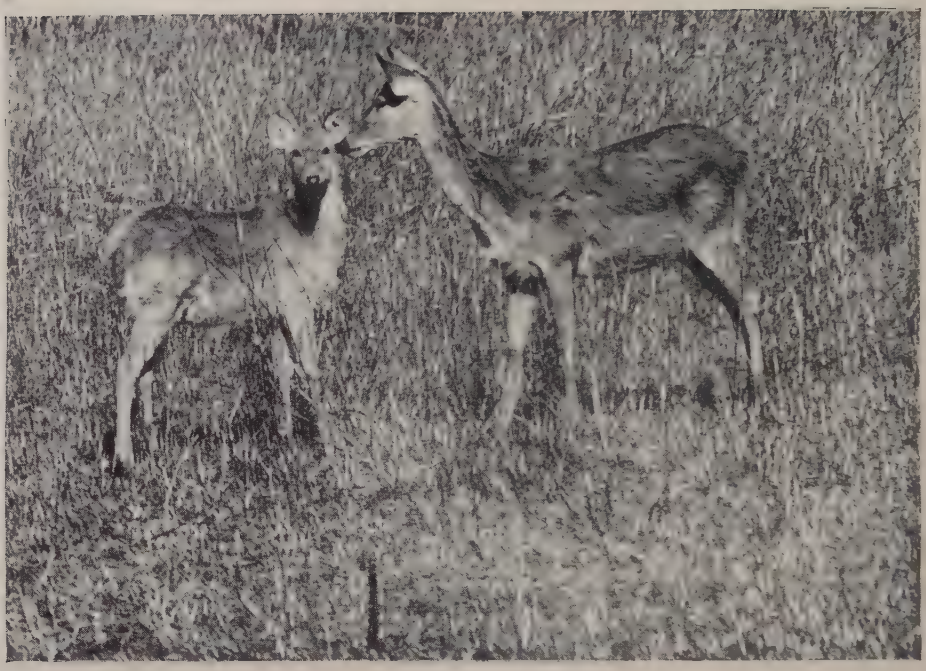
From such records and hearsay reports as are available it seems probable that gaur live to about 30 years at least—a long enough age for the animals to get to know their ranges intimately and to be severely affected by the usurpation of their territory by men.

Among shikaris it was considered that the number of annulations at the base of a gaur's horns provided a reliable indication, not of its age in years, but of its maturity. Neither the blunting of the horn-tips in old bulls nor the number of annulations at the base of the horn can be considered entirely reliable indications of the stage of life reached by a gaur. Undoubtedly there is much truth in the admirable depictions of the development of the horn in gaur provided by Forsyth, and no more dependable indications of age are available when observing the live, wild animal. However, some quite young adult bulls may develop the lateral spread of horn typical of maturity, though their horn-tips still remain sharp (photographs MP 37 and 38 show such a bull, with an almost 'handle-bar' type of horn formation). Some old, really big bulls of both the 'kinds' of gaur detailed may show a similar lateral spread with much-blunted tips (photographs TN 1 and MP 26). Neither can reliance be placed upon the blunting of the horn-tips as some quite old bulls may show one horn or both sharp-tipped (photographs TN 10 and 16). Some very big bulls with exceptionally fine horns may not show the lateral spread so noticeably (photograph TN 48). The mass of the horn seems to be a more reliable indication of maturity, but it is only positive evidence, i.e., a bull with noticeably massive horns is no doubt mature, but a mature or even a quite old bull may not have massive horns. The point need not be laboured further, but I may refer to photographs K 19 and TN 4 and TN 10: the big cow in K 19 had probably finer horns than either of the bulls shown in the other pictures. Annulations are not wholly reliable tokens. In some really old and big bulls, there is hardly any annulation visible at the bases of the horns; perhaps this is due to their having been rubbed smooth, but it seems more likely that the annulations were not deeply formed even originally (photographs TN 1, TN 16 X photographs TN 7 and TN 10). However, it is not as if a fair idea of the stage of life is not provided by observing the horns of a gaur closely, and going by overall judgement rather than by the narrow application of any rule. In fact, this is the only manner in which age can be judged, for illness, injury and other debilitating influences profoundly affect the looks of a gaur.

The consensus of opinion on the perceptions of gaur is that while they have exquisite noses, their vision is not acute and that being noisy in their movements, they depend little on their ear to warn them. Regarding their powers of hearing it is true that when following a herd of gaur it is not necessary to take great pains to tread softly so long as

Above : M.P. 1969 : KANHA N. P. : March 19 — a.m. : 2 barasingha hinds fighting — MP. 22 ; *Below :* M.P. 1970 : KANHA N. P. : March 8 — a.m. : The multi-pointer and 10-pointer lying down, with the rest of the herd grazing — MP. 27.

(*Photos : M. Krishnan*)



Above : M.P. 1970 : KANHA N. P. : March 11 — a.m. : Barasingha hind and fawn — MP. 28 ; *Below :* M.P. 1970 : KANHA N. P. : March 13 — a.m. : The big 12-pointer, the lesser 12-pointer and the multi-pointer — MP. 31.

(*Photos : M. Krishnan*)

the animals ahead are on the move, the noise of their movements covering the sound of one's footfall, but it is necessary to keep the wind right and not to show oneself openly (K 60 Apr. 14); as against this, I have known a lone bull get alerted by hearing a twig snap sharply under the foot of the riding elephant from more than a furlong away, and to bolt without turning round for visual confirmation of the sound, when he could not possibly have been warned by smell. Further, most of the intraspecific communications of gaur are through sounds, and apart from warnings being conveyed by vocal and nasal sounds, they thump the ground with their forefeet in unison during the first few yards of their getaway, as pointed out by Schaller, evidently to communicate the line of their retreat to other gaur: I should add that the sudden getaway of gaur on hard ground produces a drumming sound made by the hooves on the hard earth, not to be confused with this thumping (B 69 Feb. 3/4 and 5/6). It seems likely that their range of sensibility to sounds is different from ours and they are probably better able to appreciate subtle differences in high-pitched sounds.

Sight is undoubtedly not acute in its ability to pick out a stationary object that is not flagrantly visible. Gaur invariably turn round to stare at something that has roused their suspicions (such as the movements made by a man in cover) when they cannot get olfactory confirmation of their apprehensions; when one gaur does this, the rest may also turn in the direction it is facing, but initially they watch the alerted animal rather than what it is staring at (K 70 May 7).

Their reaction to the sight (unconfirmed by smell) of human beings varies. Nothing alarms them so much, not even the sight of a tiger, as the sight of men on foot, and their normal reaction is to bolt far and fast. Men in an automobile, as with most other animals, scare them less immediately, and occasionally men on elephant back are even accepted, provided they observe certain precautions. The gaur are perfectly aware of the identity of the men atop the elephant, but so long as the latter do nothing that alarms them, they may accept the unnatural combination of elephant and men. Gaur seem somewhat shortsighted, but are well able to make out a mobile man from over 200 yards away.

Smell, of course, is their chief sense. Wind being right, they can smell a man from over a furlong away even through the forest, and will bolt without waiting for visual confirmation: they may also wait for visual confirmation on occasion. The assessment of the perceptions of gaur by observing them is made somewhat difficult by the fact that their overt reactions to things sensed by them is bovine and stolid, and not visibly displayed till the moment of actual, acute response (such as flight). The question whether or not they can follow a ground scent has interested me for years, and I have been unable to ascertain this.

When moving through the forest, they do not put down their heads to smell the line taken by other gaur which have gone well ahead of them but, apparently, only to graze or browse.

Gaur smell the oncoming rain, facing the direction from which it is spreading (TN 62 Mar. 19—photograph TN 11); a herd out in open forest splits into parties and the parties seek the shelter of trees with thick, spreading crowns, such as *Schleichera oleosa* and *Bischofia javanica*, huddling beneath it in a compact group till the downpour is over.

Some confusion seems to exist in the records of the sounds made by gaur, but this is due to the fact that animals sounds are often difficult to indicate unmistakably in terms of onomatopoeic phrases, because some measure of personal interpretation is inevitable in such renderings. The point may be illustrated by the diverse, excellent interpretations of bird-calls in familiar phrases common in human languages. The call of *Cuculus micropterus*, for instance, is rendered in English as 'Broken Pekoe', 'Bau kotako' in Bengali and 'Kyphul pukka' in Hindi: all these renderings only serve to indicate that the call has 4 syllables, of which the first and third are probably accented: there is no agreement on vowel sounds and none at all on the consonants, the initial 'k' of the last syllable in all three renderings being fortuitous. In the interpretation of gaur sounds in onomatopoeic terms, the lack of direction or certainty to the consonants and vowels is even more marked in view of no call of the animal being reminiscent of a familiar phrase in any language.

These are the main calls I have heard from gaur. When grazing or browsing in company in a small party, usually when the undershrub is high, they sometimes come out with a low moo, almost or quite indistinguishable from the moo of Indian domestic cattle but lower (B 69 Feb. 22). Evidently this is a call used in keeping in touch, and is hardly audible from 100 feet. Cows also come out with a soft, bronchial grunt, which also has little carrying power.

The snort of surprise or alarm with the head, and usually the tail as well, thrown up and the nostrils flared, is often, but not invariably, the prelude to flight, and on a gaur coming out with this sound the entire herd takes alarm (TN 62 Sep. 14, 64 Sep. 21—photograph TN 63 shows a cow at the moment of coming out with this sound, and also 2 seconds later, placid once more, having got over her surprise at suddenly seeing men atop a stationary elephant). Although this sound is an entirely spontaneous response to alarm, the initial part of it (which perhaps consists in a sharp intake of breath) is muffled, and what follows is an eruptive snort. Dunbar Brander renders this 'pff-hong' and adds 'the "pff" is the noise made by the rush of air pastthe

Above : M.P. 1970 : KANHA N.P. : March 19 — 10 p.m. : Barasingha lying up in tall grass — M.P. 36 ; *Below :* M.P. 1970 : KANHA N.P. : March 13 — a.m. : All the 4 big Swamp Deer stags together. Probably the finest of their kind left — MP. 32.

(*Photos : M. Krishnan*)

Above : MAHARASHTRA 1969 : TAROBA N.P. : November 23 — 7 p.m. : Subadult sambar licking block of salt, near Chital Road — MR. 13 ; *Below :* BIHAR 1969 : HAZARIBAGH N.P. : February 12 — 6 a.m. : Sambar stag with an antler just shed — B. 6.

(*Photos : M. Krishnan*)

lips before the note is struck'. To my ears, the sound is definitely both nasal and eruptive, i.e., a snort.

Bulls, and cows even, come out with short, deep bronchial grunts and snorts when excited or angry, as when a tiger or leopard is seen or when surrounded by dogs.

Two calls uttered by bulls, which may be termed the herd call and the love call, are both produced in a similar manner. The herd call is a long-drawn, resonant low, pitched high and at the same time not loud even when heard from quite near, thoug h it has great carrying power and is clearly audible to human ears from half-a-mile away or longer. The call often differs in its pitch from bull to bull, some bulls having a brassy voice reminiscent of the sound of the huge, involute horns blown on formal occasions among certain tribals (B 69 Feb. 3/4 and 5/6; B 69 Feb. 22; MP 70 Mar. 20—photograph MP 38). The mode of production of this call, however, is the same in all bulls. At the start of the call (which begins on a muffled note) the head is held low, and as the call is sounded the head is slowly raised at the stretch of the neck till at the end of the call the muzzle with the lips partly open is pointing up, with the whites of the eyes showing with the effort. I have heard the call, and observed it closely from near, and photographed the bull coming out with the call, on several occasions; it is often sounded by the bulls with a herd (a composite herd) when the herd has been split by chance, as when it breaks up to shelter from a sudden downpour, and then reunites (K 60 Apr. 16; TN 62 Sep. 14, 64 Sep. 22 and 25, 66 Oct. 2—photograph TN 48). The purpose of the call is not clear, though it is clearly a communication to other gaur, usually a communication to the cows in a herd: so far as I have been able to observe, it does not attract the herd towards the calling bull, but it does seem to have the effect of halting the herd, so that till the bull rejoins the herd (as I have watched him doing) it does not wander further away.

Bulls come out with the herd call usually when separated from the herd or other gaur, though sometimes (especially when a sharp downpour has caused the bulls to leave a composite herd temporarily) the herd may be in sight. The call is one of the most evocative of all forest sounds, and has surprising acoustic properties: heard from near it is not loud, but from half-a-mile away it is still clearly audible. On occasion the same call, somewhat shorter in duration and louder, with a brassy edge to it or else a metallic drone accompanying the call, is sounded by bulls approaching a salt-lick or water, evidently as an announcement of their approach (B 69 Feb. 3/4 and 5/6; O 70 Jan. 22).

The same call, pitched louder and with a more resonant and urgent intonation to it, is used as a summons by bulls, apparently a summons in a crisis. A herd of 35 to 40 gaur with 3 big bulls in it had split into 3 parties and was proceeding along a fireline, with two parties keeping

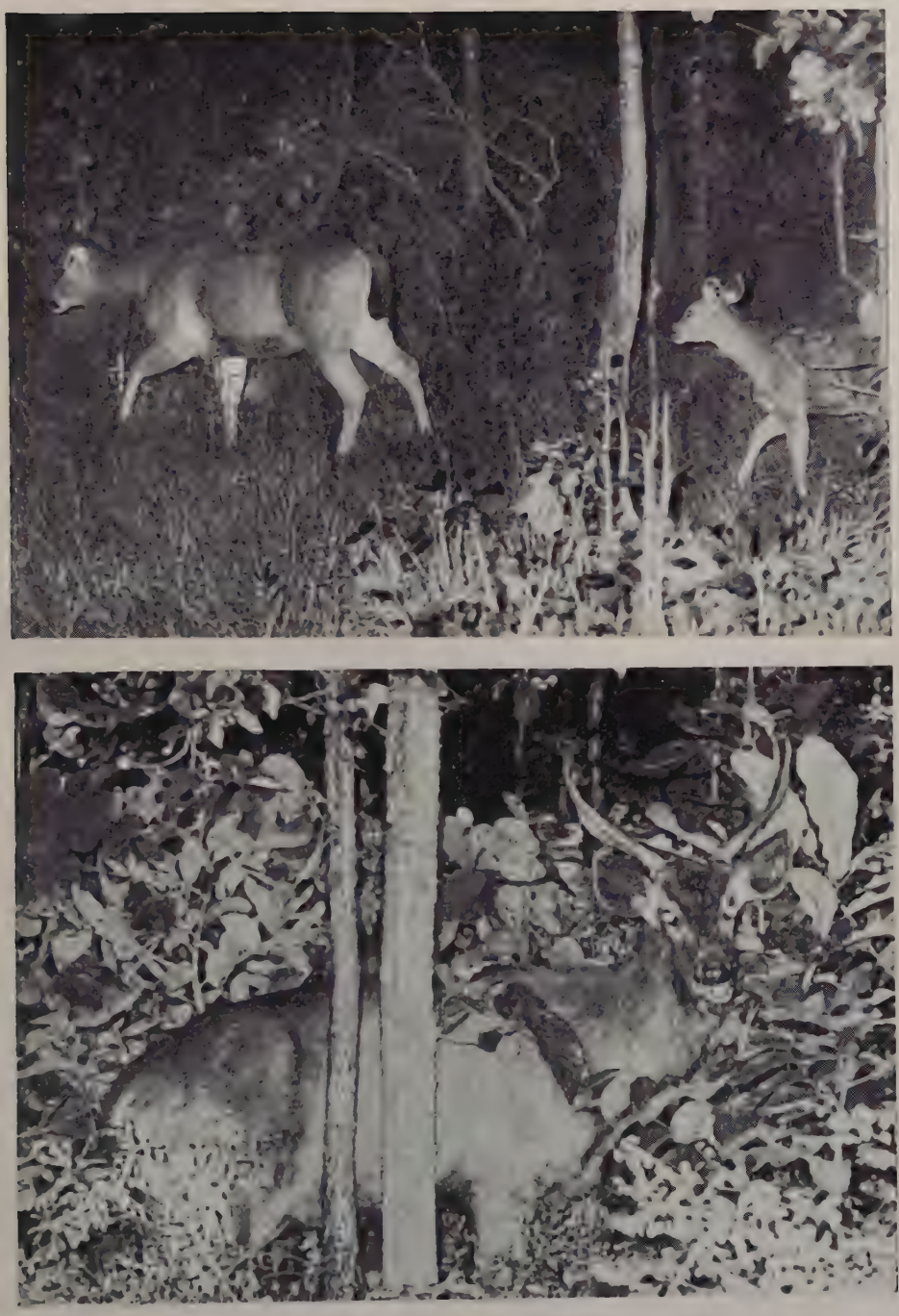
to the cleared space and one entering the tree forest across the clearing, when the leading bull came out with this call: immediately, another bull, about a furlong behind, answered the call and came up at a run, followed by the rest of the gaur also coming in at a run. A tiger, lurking in the cover of the forest, had provoked this alarm (TN 64 Mar. 31).

Variations of the herd call, not readily appreciated by the human ear, have intraspecific communication value.

The love call is also made with the head at the stretch of the neck and raised as the call is uttered, with the muzzle pointing up at the conclusion of the call with part-open lips, but does not commence with the head held low as in the herd call: it is also commenced with a hardly audible muffled sound which develops to a high-pitched whistle which vibrates to a lower tone at the end. Dunbar Brander describes the call in these words: ' Bulls when breeding, and in the herd for that purpose, utter the most absurd piping or whistling sound, more like the call of a bird than anything else, and absurd by reason of its emanating from so large and powerful an animal.' There is a measure of discrepancy to the human mind between the huge size and muscular build of the bull and this high-pitched, soft call, but the effort behind it is evident and it is absurd, if at all it seems so to the human mind not because of this discrepancy but because it is so manifestly a love-call. In all the calls of the gaur bull which are variations of the herd call (the love call may also be construed as such a variation) a striking feature is the effort behind the call and its muted commencement—even in its ending these calls often seem to trail off into silence rather than to end abruptly, and this is why I think they may have an acoustic significance to the different audile perceptions of gaur, not appreciated and probably not even heard by the human ear. The love call is invariably sounded only when the cow in season (or which is about to get into season), which the bull is so ardently and persistently courting, is near him, and it does not carry far—in the circumstances, it does not need to carry far (TN Sep. 14 and 17).

Cows do not respond to the love call or the herd call of the bulls with any vocal expressions. Calves are usually silent; I have heard a calf come out with a call only once, and on that occasion it was a prolonged, nasal, plaintive call, precisely the call of a calf of domesticated Indian cattle, and evidently addressed to its mother.

Besides these calls, the bulls bellow, apparently when angry or excited. Another vocalisation of bulls is a low, moaning and grumbling, varied on occasion with puffing expulsions of breath, indulged in while running (usually while running around in a circle) or walking, in the presence of another bull: this seems a placatory sound addressed to the other and usually larger bull (TN 63 Sep. 27, 64 Mar. 19). A bull



Above : BIHAR 1969 : HAZARIBAGH N.P. : February 14 — 8 p.m. : Sambar hind and fawn — B. 8 ; *Below :* BIHAR 1970 : HAZARIBAGH N.P. : February 3 — about 8 p.m. : A sambar stag (about 3 years old) chewing the cud, standing — B. 22.

(*Photos : M. Krishnan*)

Above : BIHAR 1970 : HAZARIBAGH N.P. : February 6 — midnight : Sambar stag — B. 24 ; *Below :* BIHAR 1970 : HAZARIBAGH N.P. : February 8 — 8 p.m. : Sambar hind and 2 brockets at the lick — B. 25.

(*Photos : M. Krishnan*)

approaching another comes out with a series of low, eruptive snorts with the head low: in response to the approach of another bull, a bull may come out with these puffing snorts (varied with hoarse grumbling sounds) while running around and swiping at the bushes with lowered horns—TN 64 Sep. 25.

Attitudes and displays are important expressive means, particularly in intraspecific communications. Horn tossing is perhaps the most important of these, and seems to differ somewhat in its display with different situations. Bulls (both bulls with herds and lone bulls) use this threat display towards riding elephants and men at times. When the demonstration is a prelude to a getaway, the head is lowered to a bush and with quick, violent sideway swipes of the horns the top twigs and leaves of the bush are sent hurtling up into the air, often to a height of 15 to 20 feet (TN 59 Mar. 8, 12, 16, a.m.). At other times, particularly when the demonstration is more aggressive and directed towards the riding elephant, the head is not lowered and no tearing up and flinging up of bushes is indulged in, but the bull takes a few steps forward quickly and tosses its head, held high or level with the back, from side to side in a menacing gesture—incidentally, this gesture is well understood by the riding elephant which, if timid, bolts (TN 59 Apr. 2, 62 Mar. 23, 63 Apr. 5—photograph TN 13). Twice a herd bull was observed covering the retreat of the herd I was following on elephant back, using this intimidatory display towards the riding elephant (TN 59 Mar. 16, p.m.—photograph TN 4—and 70 Sep. 21).

Bulls, and also cows, in a herd use a different threat (sometimes with a literally more pointed communication!), with their horns directed towards other gaur in the herd. The display has two main occasions, when it is intended to drive away some member of the herd whose proximity is resented, and when it is intended to direct a subordinate animal in the lead—the second occasion is dealt with in the note on leadership. When used as a driving-away display, as by one bull towards another (especially when the latter is running with a cow) or by one adult cow towards another cow (cows never use this display against bulls, and bulls do not usually use it towards cows), the head is lowered and the gaur lunges at the animal it wishes to move with its horns: this is usually sufficient to shift the object of hostility a safe distance away, but this display is so sudden that often it is not only a formal gesture, but an actual attack, whether intended as such or not, with the demonstrating animal getting home with its horns on the animal towards which the display is directed, with the natural consequence that the retreat of the latter is even more precipitate than it would have been otherwise. Two bulls in a herd, each running with a cow, were seen using this display towards a third and older bull in the herd (TN 62 Sep. 14); the big bull in a herd, no longer running with a cow, was

seen repeatedly threatening a young bull with this display (TN 63 Sep. 25). Cows were also seen threatening other cows with it.

The goring of termite mounds is probably mainly a form of redirected aggression, as thrashing bushes is, but perhaps it also serves to scrub the boss between the horns and the hollow beneath it—on two occasions, when a big bull was observed demolishing a termite mound, it was noticed that the boss came into intimate contact with the mound and was rubbed against it (TN 64 Apr. 10 and O 70 Sep. 27). Bulls thrash the bushes frequently with their horns when not running with a cow (TN 63 Sep. 27). Sparring is uncommon in herds where the dominance values have already been established, and was not observed as a prominent feature—in such gregarious associations, the threat display or actual prodding with the horns took the place of sparring.

Schaller attaches much importance to the lateral display, common in most bovines when two adult bulls approach each other, and describes it fully. In this, the demonstrating bull presents his profile to the other, with his back held somewhat hunched and the feet close together: naturally the other bull has to be more or less at right angles to the bull demonstrating for the effectiveness of this display as interpreted, but need not be head-on to it, for gaur have lateral vision and even if the other bull is side-on to the displaying bull, the profile would be seen. But it was noticed that the displaying bull stays put while the other is moving and often moves at an angle where he can only see the displaying bull end-on: the bull displaying does not reorient himself to present his profile to the other bull. Further, it was noticed that even when the approach of the oncoming bull was oblique, with the bull displaying at an acute angle, the display was staged. All this was noticed in the course of attempts in 1962–64 to photograph the lateral display in the Mudumalai Sanctuary, and the one clear picture taken is not reproduced here as it is too long, in format, but a big print of it is with the Bombay Natural History Society (titled 'No longer on talking terms'): it shows the two bulls both adopting the lateral display and more or less in a line, facing opposite directions, so that they cannot possibly see each other. I should add that this was not a display directed at me on the riding elephant, as the elephant was kept far away and moved in for the picture only after an impasse had been reached in the display of the two bulls. A comparison of photographs TN 39 (which shows a bull adopting this tense, somewhat hump-backed posture with the feet close to one another and the head low) and TN 49 (which shows a bull in profile standing at ease) will indicate the attitude assumed by the displaying bull.

Whatever may be the significance of the lateral display in bison and other wild bovine animals, I do not think that in gaur it has an

Above : BIHAR 1970 : HAZARIBAGH N.P. : February 9 — 6.30 p.m. : Sambar hind and fawn — B. 26 ; *Below :* BIHAR 1970 : HAZARIBAGH N.P. : February 9 — 7 p.m. : Sambar stag, near suspended block of salt (not shown) — B. 27.

(*Photos : M. Krishnan*)

Above : BIHAR 1970 : HAZARIBAGH N.P. : February 12 — about 6.15 p.m. : Sambar stag rolling in the mire — B. 28 ; *Below :* BIHAR 1970 : HAZARIBAGH N.P. : February 12 — 10.40 p.m. : Head of an old stag : picture out of focus, but still shows the robust development of the brow-tines — B. 29.

(*Photos : M. Krishnan*)

aggressive intent. It seems to be essentially a non-combative or placatory display, and what is more, for its effective communication it need not be lateral and may well be oblique or even end-on. Schaller also thinks that it obviates actual conflict (the purpose of almost all displays) but while it may, it also may not. The same difficulty arises in interpreting the desultory, formal grazing indulged in by two bulls in the presence of each other as a gesture of subordination: both graze in this manner, and may graze gradually closer to engage in sudden, violent combat (TN 63 Sep. 27—photograph TN 31). A quite extraordinary end to a combat between two bulls belonging to different herds was observed, in which the 'chela' (subordinate bull) of one of the combatants, a brown bull smaller than either combatant, rushed in with moaning sounds, snorts, and violent horn-tossing, followed by the entire herd of the bull to which the 'chela' belonged separating the fighting bulls and sending them back to their herds (TN 63 Sep. 27). Schaller cites the wounds and tattered ears of fully adult ('black') bulls as evidence of their having indulged in sparrings: wounds are received in major fights between bulls, and to judge from the violence and savage, all-out thrust of combatants on such occasions (photograph TN 31) deep-gored wounds might well result in such encounters, but tattered ears are not, generally, the result of fighting. The ears are not exposed to attack in such fights, and it is much more likely they get torn in the passage of the animal through spiky cover. That gaur do enter and move through dense spiky cover is a fact (TN 62 Sep. 20) and on the sides of many animals the marks left by twigs and thorns brushing against them are visible, not as scratches usually but as lines marked on the coat (photograph TN 49).

Licking is, in certain contexts, the most important communicative means employed by gaur. Subordinate bulls ('chelas') lick and nuzzle the master bull, which may or may not accept the placatory blandishment (TN 63 Sep. 27, 64 Oct. 7). Bulls and cows running together during courtship lick each other. However, the most important function of licking is in the mother-infant relationships of gaur. Newborn calves are literally licked into shape, the long, steady strokes of the tongue of the mother evidently providing a lingual massage supplemented by the chin of the cow also rubbing against the calf during the movements of her head while licking (TN 62 Sep. 14, 63 Mar. 17—photograph TN 22 shows a newborn calf). Cows do not depend upon vocal summons in calling very young calves (though they moo to older calves) but go up to them and lick them to induce the infant to follow them, even when an acute situation where they apprehend danger to their young arises: calves, both when old and when very young, are fascinated by elephants on occasion, and will follow them (TN 63 Sep. 17). On one occasion, when an infant calf

came up to a riding elephant which seemed nervous of its approach and directed a spray of spittle from its trunk at the calf, the mother (a young animal—this was possibly her first calf) came close up to the elephant to lick and retrieve her young (TN 64 Apr. 8—photograph TN 36).

There seems to be some confusion over the question of the leadership of a herd or party. In a herd, usually spread out over a considerable extent of forest, it is obviously not possible for any member of the herd to take on the important function of sounding the alarm when danger threatens: any member may snort in alarm, and instantly the entire herd is alerted (TN 62 Sep. 14). In a small party of 6 to 10 gaur, it is much easier to perceive that the leading animal, usually a young cow or bull, is not the leader. I have observed this on many occasions, and it is usually a mature cow (or it may be the big bull of the party) that gives the directions to this leading subadult or young adult: it rushes up and prods it or threatens it with a display of tossed horns, to make it take a definite line and go ahead (TN 63 Apr. 2, 66 Sep. 28). On occasion the big bull of even a large herd may, wishing to turn the herd in a particular direction, come up to the middle of the herd, stop, turn pointedly and lead: he may, while grazing away from the herd, come up to the herd and summon it with a herd call (K 60 Apr. 16) or, more usually, merely by showing himself and then turning back and leading the retreat (K 70 May 4 and 9). The bull usually leads the retreat when a herd is headed away and turns back, because the big bull is usually at the rear end of the moving herd. While grazing, some animals may stand still, chewing the cud on occasion, and obviously these are in a better position to sense any threat than the animals that are grazing, but no regular sentries appear to be posted; similarly, when gaur lie down for their siesta, a few animals may remain standing, and when these lie down, others may get up (TN 62 Sep. 17—photograph TN 18); however, I have seen the entire herd lying down for a long rest, without any animal being on its feet.

When followed, lone bulls and even herd bulls tend to lie down in tall grass, and evidently this is a purely instinctive reaction since very often such grass as there is does not hide them at all (TN 59 Mar. 9—photograph TN 1—59 Mar. 16, 66 Sep. 26—photograph TN 47). In considering their alertness and tendency to lie up in this manner, it should be remembered that on the uneven ground they generally favour gaur are quite fast and surefooted. I once saw an entire herd of 23 animals leap clean across a 10-foot wide nullah, and on slippery ground after rain where the riding elephant (an unusually surefooted beast) found considerable trouble in negotiating the steep slopes, the gaur were moving fast with no difficulty (TN 59 Mar. 15 and 62 Sep. 15 and 16).

Above : TAMIL NADU 1959 : MUDUMALAI SA. : Kargudi : March 15 — a.m. : Sambar hind, looking back at me — TN. 2 ; *Below :* TAMIL NADU 1962 : MUDUMALAI SA. : Kargudi : March 13 — a.m. : Sambar hind eating nelli — TN. 8.

(*Photos : M. Krishnan*)

Above : TAMIL NADU 1962 : MUDUMALAI SA. : Kargudi : March 21 — a.m. : Sambar hind and fawn : Note sore-patch — TN. 12 ; *Below :* TAMIL NADU 1962 : MUDUMALAI SA. : Kargudi : March 24 — a.m. : Gravid sambar hind with extensive sore-patch — TN. 14.

(Photos : M. Krishnan)

The main predators that gaur have to be on their guard against are men, and to a lesser extent tigers, and to a much lesser extent leopards. In a herd they seem to have little to fear from tigers, and do not run away but mass together in a prominent musk-ox formation, with the young in the centre and the bulls and the big cows on the periphery. I noticed this reaction to a tigress that was circling a large herd with several calves in it in the Kargudi area of the Mudumalai Sanctuary late in September 1958, and again in the same area in 1964, though on the latter occasion the tiger was not seen (TN 64 Mar. 31). No doubt tigers occasionally prey upon calves and young gaur, and rarely on full-grown animals (B 69 Feb. 17—photograph B 11). Leopards, apparently, occasionally take young calves, when they can. A small leopard was seen intently watching a herd of gaur in which there were calves, and when the leopard bolted on seeing us, the gaur cows saw it, snorted and rushed towards it at a fast walk with heads low, tossing their horns (TN 62 Apr. 7). On another occasion, the cows similarly rushed snorting at a big leopard which, seeing us on elephant back, was proceeding up a rise which they topped from the opposite side—the leopard vanished into cover with a jump (TN 59 Mar. 25). Men undoubtedly constitute their chief enemy, and gaur are terrified of men on foot. I have walked almost right into a lone bull in tall grass, who being aware of my movements though I had no inkling of his presence, was waiting for me standing up alert: he crashed away when he saw me, from about 6 feet away. I believe that it is seldom or never that gaur attack men when not provoked and when a line of retreat offers. Of course there are records of men having been killed and savagely ground underfoot by gaur bulls which they have wounded and followed up to kill: gaur, like elephants and other large vegetarian animals, do not know when to stop killing when they kill men, and may grind the remains into the earth. However, gaur are probably the most placid and inoffensive animals of their size anywhere in the world, and do not of their own accord attack men. Dunbar Brander points out, very rightly, that gaur cannot be driven. They just walk or run past the men seeking to encircle them. On one occasion, when an attempt was made to encircle a large composite herd of gaur so as to display it to some visitors, in the Mudumalai Sanctuary, the result was that the entire herd left the area at once (TN 62 Sep. 22).

When wounded severely, whether by men or other gaur or predators, gaur seek retreat in cover, and evidently recover from grievous injuries and set-backs. Schaller comments on gaur being specially prone to injuries, most of them incurred in the course of intra-specific fights and accidents. Even not taking into account their great mass and the precipitous terrain they often inhabit, gaur are no

more prone to accidental falls than most other animals—chital and sambar, too, are sometimes seen with wounds and other injuries. In fights between bulls, great care is taken not to expose a flank to the adversary, the fights being generally a head-on clashing of horns with the entire thrust of the body behind the horns (photograph TN 31); however, when the defeated bull turns to flee, he has to expose his flank and hindquarters, and the victor may and does at times get in a quick jab—this happens among chital also and there is no instinct inhibiting such attacks by the defeated bull exposing itself to attack. Injuries to the hock, resulting in permanent lameness, may be caused by a tiger attempting to hamstring an adult gaur: I have personally known a tiger seeking to immobilise a big domestic cow buffalo by biting her in the hock, before the buffeting horns drove him away. During the survey period several hundred different gaur were seen, and only a few carried major wounds or other injuries; an old lone bull lame in the hind leg (TN 62 Mar. 18), an old lone bull with deep, long flesh-wounds suggesting injury from the claws of a tiger (TN 63 Mar. 21), a big cow with what looked like gunshot wounds high up the shoulder (TN 63 Mar. 25), a big bull with bloody, gored wounds accompanied by a 'chela' (TN 64 Oct. 7) and an old limping cow (B 68 Apr. 28).

The night vision of gaur seems fair. Approaching an artificial salt-lick in the Kanha National Park at night, near which men in a stationary jeep were keeping very still, they spotted the men from about 200 feet away by moonlight and approached in a series of jerky advances, irresistibly bringing to mind the movies of the old 'silent days' when the projector was behaving in an erratic manner (MP 70 Mar. 17—photographs MP 34 and MP 35).

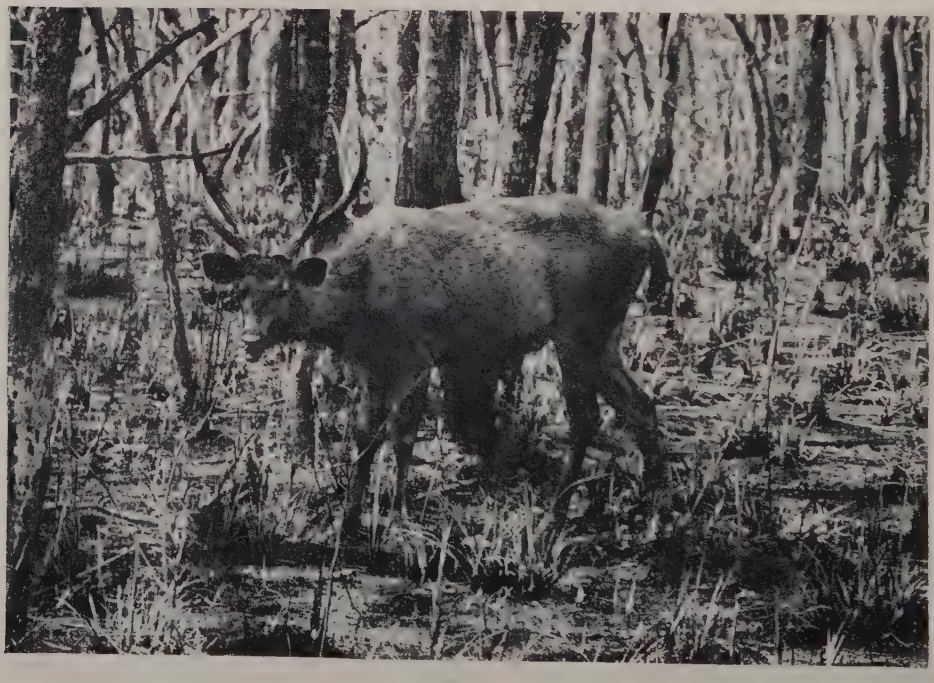
An important aspect of the night behaviour of gaur at the Kanha National Park (important because of its general application to most animals in areas where they are much disturbed by day and stay in cover during the daytime, though normally diurnal) is that at night they are much less apprehensive of men than by day (MP 70 Mar. 5—photograph MP 26).

In a herd, the calves generally keep more or less together (as do their mothers), either in the middle of the herd or, occasionally, in the vanguard (TN 63 Sep. 17). Generally each cow has only one calf running with her and one calf at a birth is the rule, but occasionally I saw two young calves running with a cow, once after an interval of days (TN 62 Sep. 17 and 22, 64 Mar. 31).

The big bull (or bulls in a composite herd) may be anywhere in the herd, or near it, but when the herd is on the move, it is usually in the rear.

Above : TAMIL NADU 1963 : MUDUMALAI SA. : Kargudi : April 3 — p.m. : The big sambar stag alert with suspicion — TN. 26 ; *Below :* TAMIL NADU 1964 : MUDUMALAI SA. : Kargudi : April 5 — 11.30 a.m. : Sambar by the fire. Note smoke — TN. 35.

(*Photos : M. Krishnan*)



Above : TAMIL NADU 1966 : MUDUMALAI SA. : Kargudi : April 9 — p.m. : Sambar hind clearly showing the sore-patch and the white mouth of the opening in the middle — TN. 44 ; *Below :* TAMIL NADU 1966 : MUDUMALAI SA. : Kargudi : April 19 — a.m. : Sambar stag in the dry forest — TN. 45.

(*Photos : M. Krishnan*)

The question of herd composition is complicated by the free-ranging habits and longevity of the animals, and by their familiarity with their stamping grounds which makes it possible for them to move in detachments rather than in a tight herd. The only way to determine the question is to follow a herd through all its wanderings and vicissitudes for at least 2 years, keeping a daily record of observation, though the observation need not be from near. My own attempts at securing some photographic evidence of the same gaur at the Theppakkadu area of the Mudumalai Sanctuary during consecutive years in September-October (when the composite herds usually arrive at the natural teak forests), based on observation of the gaur here in 1962, 63 and 64, were frustrated by the work being interrupted in 1965, and by the rinderpest epidemic that drove the gaur (the survivors) out of the area in 1968 and 1969—even in 1970, only a few gaur were found here.

It is not claimed that on the basis of my observation notes and photographs I can conclusively prove what follows, but neither can any of the others who have advanced opinions on the point prove their views. As already said, the only way to secure positive proof is to follow a herd over a period of years.

Unlike chital, and like elephants, gaur seem fairly stable in their herd composition. Some confusion has arisen over the issue by not allowing for the herd never being a rigid, immutable unit of numbers seen constantly in association—by such a test, the concept of a family among ourselves cannot be sustained. Herd composition is further complicated by two diametrically opposed tendencies. When moving to fresh feeding grounds as seasonal variations and needs may dictate, two or more herds may keep together for the time being, forming a composite herd in which the structure is necessarily unstable. The reverse position also obtains: a herd shifting to new grounds may break up into small parties and it is only at the ultimate destination that these parties may reassemble into the herd again (TN 64 Mar. 17, p.m., 66 Sep. 24, a.m.). In some places, as in the Kanha meadows, when the herds move in in this manner, there may be loose, shifting associations between the parties belonging to different herds for a period before each herd settles down. This tendency of the herd to split into parties may also be noticed when it is foraging by day (in areas where gaur feed by day, as is their natural habit); the big bull, and other adult or near-adult bulls in the herd, may keep well away from the herd till nightfall, and even the cows may split into a number of parties which may be at some distance from one another. This may be observed in the Periyar Sanctuary, where there is a large herd in and around Aiyappan Kurukku: photographs K 31, K 32, K 33 and K 34.

However, the same animals are to be seen in association in the same place at intervals of several days (TN 59 Mar. 26 and 31, 62 Sep. 14, 15, 16 and 17, 63 Sep. 13, 15, 16 and 22, and 25 and 27, 64 Sep. 22, 23 and 25). Further, the same animals may be seen in composite herds in the same area during successive years.

Sanderson and his contemporaries assumed that lone bulls among gaur were the master bulls of herds which had been ousted by younger and stronger rivals when past their prime. Dunbar Brander thought that herd bulls lost their interest in the cows comparatively early in their lives, and thereafter preferred to stay by themselves as lone bulls—this does not explain the existence of young solitary bulls which, so far as is known, also stay away from herds. Dunbar Brander and, following him others, thought that the master bulls of herds associated with the cows only during the breeding season—this, after realising that in gaur there was no defined breeding season.

Broadly speaking, gaur are polygamous: all that is meant by the term here is that the bull in the course of breeding associates with several cows in the herd, as they come into season: such polygamy does not preclude the existence of a matriarchal hierarchy among the cows. Normally only one master bull is to be found in a herd, though occasionally there may be two, one being definitely the larger and more dominant: in a composite herd, on the other hand, there are invariably more than one fully developed bull, usually from 2 to 5, depending on the size of the herd. Further, each of the bulls in a composite herd may be running with a cow in season or about to come into season—such bull-cow pairs generally keep a little to one side of the herd, and do not get into one another's way. In addition to these fully developed bulls, there may be one or more near-adult brown bulls. But the one constant feature of any sizeable herd, single or composite, is that invariably there are many more cows than bulls among the adults, while the sex-ratio is probably equal among subadults and calves. This is why a herd may be termed polygamous even if, as some seem to think, the entry of bulls into the herd when a cow is in season is promiscuous. I have never seen more than 2 adult bulls in a herd of about 20 animals, whereas nearly 60% of such a herd is made up of adult cows, which usually outnumber the bulls, calves and subadults put together. I give below the sex counts for some herds, chosen at random from the field notes:

TN 59 Mar. 26: 33 gaur. 2 fully developed bulls, one near-adult bull, 4 subadults of undetermined sex, 5 calves, 21 adult cows.

TN 62 Sep. 14: 40 gaur, composite herd, 3 fully developed bulls, 2 near-adult bulls, 4 subadults of undetermined sex and 4 old calves and 2 young calves, 25 adult cows.

Above : TAMIL NADU 1970 : MUDUMALAI SA. : Masinagudi : September 16 — p.m. : Young sambar hind — TN. 59 ; *Below :* MAHARASHTRA 1969 : TAROBA N.P. : November 19 — about 7 p.m. : Sambar hind and young (male) — MR. 10.

(*Photos : M. Krishnan*)

BIHAR 1969 — HAZARIBAGH N.P. : February 14 — 7 p.m. : Portrait of a sambar hind. Note the whorl of hair on the throat and the absence of a sore-patch — B. 7.

TN 62 Sep. 17 : 35 gaur, of the larger brown 'kind', a composite herd. 3 fully developed bulls of which two were old, 3 young bulls, 6 subadults of undetermined sex and 4 half-grown calves and 3 young calves, 16 adult cows (photograph TN 19).

TN 63 Mar. 12 : 9 gaur. No adult bull, 3 subadults with 3-inch spike horns, one calf about 6 months, 5 adult cows.

TN 63 Sep. 17 : 33 gaur of the larger brown 'kind' in a composite herd. 3 fully developed bulls, 1 near-adult bull, 4 calves and 4 subadults of undetermined sex, 21 adult cows.

TN 66 Apr. 20 : 23 gaur in a single herd, of the smaller 'black' kind. 2 fully developed bulls, 1 near-adult bull, 2 calves and 6 subadults of indeterminate sex, 12 adult cows.

K 70 May 7 : 38 gaur in a localised herd. 2 fully developed bulls, 1 smaller brown-black bull, 5 subadults and 3 calves of undetermined sex, 27 adult cows (photograph K 31).

B 69 Feb. 3/4 : 7 gaur at the Ligirda lick in a party. 1 adult bull, 1 subadult bull, 2 subadult cows, 1 half-grown calf, 2 adult cows.

MP 70 Mar. 17 : 16 gaur at the Sravantal lick. 1 adult bull, 2 calves, 2 or 3 subadults, 10 adult cows.

The total number of gaur in the above random samplings from the notes comes to 234, and the adult cows in these herds and parties to 139, representing a percentage of 59 of the total population—naturally, lone bulls have been left out of this reckoning as also herds seen without any bulls in them. The number of cows identifiable as such in 20 photographs (only 2 of which are reproduced here, i.e., TN 20 and K 31) which are representative pictures of herds, was counted and the percentage of cows to all animals in the herds again came to 60. These figures will go to show to what exent adult cows predominate in a herd.

Schaller and a few others have written about the 'rutting bull'. I am unable to comprehend the connotation of the term. In gaur, as among all cattle, it is the cow's coming into season that determines mating. The sexual act, as in all bovines, is completed in a few seconds but the courtship extends over days. The rut may be strictly defined as sexual excitement in the male of any species, and if the suggestion in terms such as 'rutting bull' and 'rutting season' is that there is a seasonal abundance of virility and increased sexual desire in gaur bulls that conditions breeding, the suggestion is entirely unwarranted. It is solely the cows getting into season that determines breeding, and there is no seasonal periodicity in this: as in domestic cattle, gaur cows in a herd come into season at different times, each cow having her own œstral cycle.

The field notes provide the probable age of calves seen, classifying them into very young (definitely under 2 or 3 weeks old) and older (from 1 to 6 months) calves. Ignoring the estimated age of the older

calves, and taking into account only the newborn calves and calves definitely under 2 weeks of age, and assuming that the period of gestation in gaur is 9 months (this is near enough), analysis of a few records of calves seen provides the following information regarding their conception :

TN 59 Mar. 26 : 1 golden sienna calf, about 1 week old, in a herd of 23 ; must have been conceived mid-June.

K 60 Apr. 14 : 1 golden sienna calf under 2 weeks, along with older calves, in a herd of 16 ; must have been conceived early July. Photograph K 7.

TN 62 Sep. 14 : Newborn calf, about an hour old, being licked by its mother ; must have been conceived mid-December.

TN 63 Mar. 17 : Newborn calf, less than an hour old. Must have been conceived mid-June. Photograph TN 22.

TN 64 Mar. 23 : 3 very young (under 2 weeks) golden brown calves in a herd of 19 ; must have been conceived about mid-June.

TN 66 Sep. 30 : Cow with newborn calf ; must have been conceived end of December.

MP 70 Mar. 15 : 1 calf about 1 week in party of 16 ; conceived mid-June.

TN 70 Sep. 15 : 1 calf under 2 weeks in a herd of 15 ; conceived early December.

At first sight this may suggest that there are two main breeding periods, in June-July and in December-January. Such a conclusion is entirely unwarranted and fallacious : it ignores two very relevant facts, i.e., that all these observations were made in March-April and in September, and more important, that there were older calves, from 3 to 6 months old seen with the herds in which these young calves were seen. A few random selections from the field notes will establish this, and it is important to note that even if the estimates of the ages of the calves observed are out by a month or two either way (though I do not think they were) it makes little difference, for once the fact is established that calves of from 3 to 6 months were also seen in March-April and September-October, the extension of the 'breeding period' by several months is also established.

TN 62 Mar. 24 : 3 calves of from 4 to 6 months ; conceived late February to late December. Photograph TN 15 shows a 4 months' old calf.

K 60 Apr. 14 : 3 calves from 4 to 8 months ; conceived March to December. Photograph K 7.

TN 66 Apr. 20 : 1 very young calf and 1 calf about 3 months ; conceived July and April.

It will now be seen that the 'breeding season' extends from February to July and from December to January ; i.e., only the months of August, September, October and November are left uncovered by the evidence so far adduced. Gravid cows were also seen on occasion (for instance a heavily gravid cow seen TN 62 Mar. 24 and a gravid

Above : M.P. 1969 : KANHA N.P. : March 10 — night : A chital stag with fine antlers feeding on the roadside — MP. 16 ; *Below :* M.P. 1969 : KANHA N.P. : March 12 — a.m. : 2 parties of chital near each other in passing — MP. 17.

(*Photos : M. Krishnan*)

Above : M.P. 1969 : KANHA N.P. : March 13 — p.m. : The big chital stag : Note massive antlers — M.P. 18 ; *Below :* M.P. 1969 : SHIVPURI N.P. : April 2 — p.m. : A chital stag showing very large white spots — M.P. 25.

(*Photos : M. Krishnan*)

cow seen TN 62 Sep. 14) but less speculative evidence is available. A few records from the field notes of bulls actively courting cows in season (or about to come into season) and attempting to mount them will provide this evidence : apart from the bulls nuzzling the cows and resting their chins on the rumps of the cows they were running with, love calls and the smelling of the genitals and urine of cows with retracted lips and the head held pointing upwards at the stretch of the neck (*flehmen*) are taken as additional evidence of the 'breeding season'.

TN 62 Mar. 24 : A single adult bull in a herd of 21 courting a cow, following her assiduously ; attempted to mount her ; smelt her urine with curled lips and head held pointed up ; nuzzled her rump.

TN 62 Sep. 14 : Sep. 15 & Sep. 17 2 dominant bulls in a herd of 40, containing another older bull and a near-adult brown bull, both kept away from the proximity of the 2 dominant bulls. Younger of the 2 dominant bulls courting a mature cow and the older a young cow. Both bulls came out with the love call, smelt the cow-urine and rested their muzzle on the rumps of the cows. The bull with the older cow tried to mount her several times but she would not stand to him.

In September I saw a cow attempting to mount another, a sure sign that the former was coming into season (TN 64 Sep. 24: I have a photograph in proof). Another record of a bull courting a cow in September is provided by TN 63 Sep. 22. From all this it is seen that gaur breed all through the year, and that only for the months of August, October and November is no evidence of their breeding available. This is so because during these 3 months I did not observe any gaur anywhere intensively. But even conceding, hypothetically, that gaur do not breed in October and November, that surely does not warrant the use of the term 'breeding season' and 'peak breeding season' and the term 'rut'. The fact is there is no defined breeding season in gaur, that they breed all the year round, and that any increased breeding activity noticed is consequent on more cows coming into season, an event that may be conditioned by so many factors that it cannot be linked up with the calendar.

The next thing to consider is the statement made by Dunbar Brander and others that during the 'breeding season' bulls come into the herds to breed. My experience is that the associations of big bulls with herds is not promiscuous or a matter of chance and seizure of opportunity. The big bulls belong to the herds, and they may be grazing away from the herd for the time being and then come back into it (whether or not the cows in the herd are in season)—some actual instances of the return of the bulls to a composite herd are available in the field notes : TN 63 Sep. 27, 64 Mar. 23, Sep. 22 and 25, 66 Sep. 28 and Oct. 2.

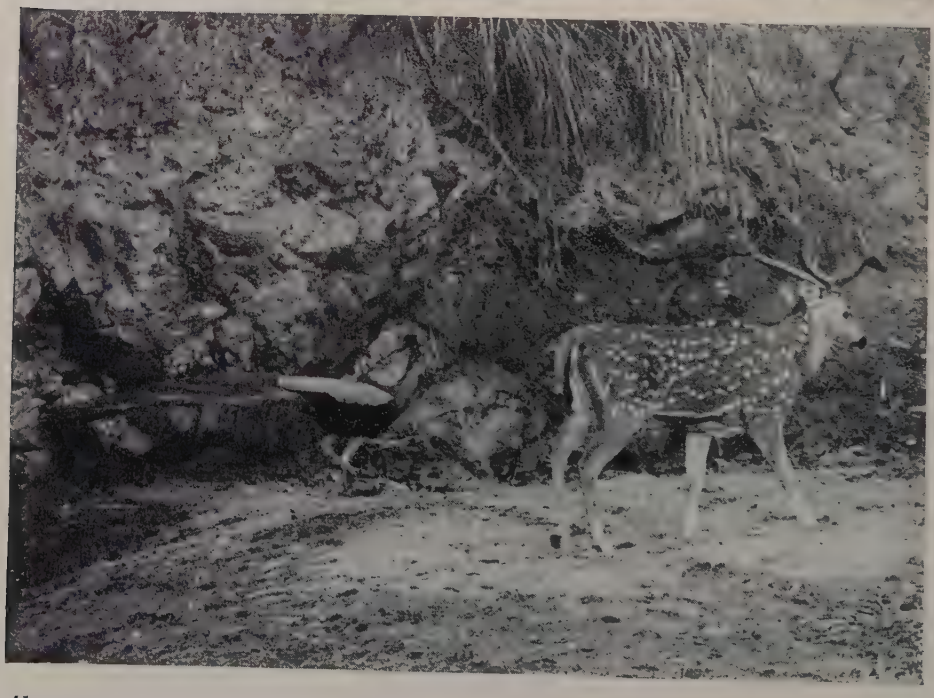
Bulls in a herd do not passively accept the presence of another bull when they are running with a cow, or when they are in the herd but no cow is in season—TN 62 Sep. 14, 63 Sep. 25, 66 Apr. 20.

The question of lone bulls may be taken up now. In areas specially favoured by gaur, such as the north-eastern slopes of the Nilgiris constituting the Mudumalai and Bandipur sanctuaries, lone bulls may be seen of varying ages. All are adult, but some are young adults and some old, or very old. Whether they have left the herd in which they were born and reared voluntarily or not, they do not seem to associate with herds. Considering the hostility shown by the master bulls in herds towards the near-adult bulls, it seems likely that the younger lone bulls are animals that have walked out of the herd to escape being harried by older, bigger herd bulls: if that were so, they would probably get into a herd if they could. The old lone bulls never rejoin a herd, but are truly solitary, though at times they may keep company with another big lone bull. Associations between young lone bulls are not unknown. To give a fair idea of the common occurrence of lone bulls in areas favoured by gaur (since it seems as many male as female young are born, to balance the predominance of adult cows in herds there must be many lone bulls). I give the total number of lone bulls seen during the survey period, and the number of herds and parties seen: no doubt some of the lone bulls were seen twice, thrice and one even four times over, but so were the herds, and such repetition in counting being common to both and not of any appreciable frequency, the two counts may be taken as representing a fair proportion of lone bulls to herds. In all lone bulls were seen on 52 occasions and gaur in herds or parties on 114 occasions. Considering that every lone bull seen represents only one male, and the 50 to 60% ratio of adult cows in herds represents several hundreds seen, there is no counter-balancing evident.

The incidence of cattle-borne epidemics among gaur and the way these affect their survival and distribution may be briefly set out. Sanderson, Dunbar Brander and others write of rinderpest accounting for the entire population of gaur in certain localities. Rinderpest seriously affected the gaur in Karwar in June 1944, and about August 1968 took heavy toll of the gaur in the Mudumalai and Bandipur sanctuaries, perhaps the finest stamping ground of gaur anywhere in their distribution in S. E. Asia. Actual figures of the corpses recovered in both sanctuaries are not available, but it may reasonably be assumed that from 300 to 500 animals of all ages died. A remarkable feature of the epidemic, as I heard it reported from those who had actually seen the afflicted gaur in the Bandipur sanctuary, was that when an animal in a herd was stricken it left the herd and sought cover, and the rest panicked and bolted to areas around, even to areas

Above : M.P. 1970 : KANHA N.P. : March 11 — 7.45 p.m. : A chital stag in velvet grazing : Note exceptionally fine antlers — M.P. 29 ; *Below :* M.P. 1970 : KANHA N.P. : March 11 — 8 p.m. : A party of chital stags — M.P. 30.

(*Photos : M. Krishnan*)



Above : BIHAR 1969 : BETLA : PALAMAU : February 21 — 9.30 a.m. : Chital drinking at Madhuchuan — B. 13 ; *Below :* BIHAR 1969 : BETLA : PALAMAU : February 25 — a.m. : Chital and peacock leaving the water at Madhuchuan after drinking — B. 17.

(*Photos : M. Krishnan*)

Above : BIHAR 1969 : BETLA : PALAMAU : February 25 — a.m. : Chital hind at Madhuchuan stamping her forefoot — B. 18 ; *Below :* BIHAR 1969 : BETLA : PALAMAU : February 26 — a.m. : Limping stag with unequal antlers, Madhuchuan — B. 19.

(*Photos : M. Krishnan*)

Above : BIHAR 1970 : BETLA : PALAMAU N.P. ; February 21 — about 8 p.m. : Chital — B. 31 ; *Below :* BIHAR 1970 : BETLA : PALAMAU N.P. : February 23 — 7.10 a.m. : Chital drinking at Madhuchuan — B. 33.

(*Photos : M. Krishnan*)

to which they normally do not go. In September-October 1970, fully 2 years after the disaster, the gaur were returning to these sanctuaries in small numbers. This infection was traced definitely to the decrepit cattle being herded through the two sanctuaries to slaughter-houses. In 1966 I saw the corpses of gaur that had, apparently, died of some epidemic in the Mudumalai area of the Mudumalai sanctuary (TN 66 Apr. 15 and 16); foot-and-mouth disease had spread from cattle to sambar and gaur in that year in the sanctuary, and I saw an old bull badly stricken by the infection (TN 66 Apr. 27).

THE WILD BUFFALO

Bubalus bubalis (Linnaeus)

(Summary of field notes : Observation records outside Assam limited to tracks and dung seen at Balimela in Orissa and in the Bastar area of Madhya Pradesh. *Photograph* : MISC 4A.)

The wild buffalo appears to be indigenous almost exclusively, having originated in India and Nepal. Formerly, when it had a far wider range in India than now, it was found in the riverain tracts of north-east India, from the Godavari upwards.

Most strains of domesticated buffaloes are derived directly from the wild buffalo, which they closely resemble except for being smaller-sized and less aggressively wild in varying degrees; those domesticated strains living in a semi-feral condition (as in Bokkapura, in the Nilgiris) are noticeably larger and fiercer than ordinary village buffaloes. When truly feral, they regain much of the size and wild spirit of their wild ancestor.

The buffalo was domesticated and highly valued for its milk from quite ancient times, and introduced into countries as far as China and Japan to the east and Italy to the west. F. E. Zeuner (A HISTORY OF DOMESTICATED ANIMALS) provides a succinct account of the early domestication of the Indian wild buffalo and its export abroad. The earliest extant Tamil poetry (approximately 19 centuries old today) contains references to domesticated milch buffaloes and the high regard in which they were held, but does not mention the wild buffalo, though it mentions the gaur. There is no authentic account of the wild buffalo in South India within historic times.

In recent times, the Indian domesticated buffalo, exported to Australia, has run wild in that country, and there is reason to think the wild buffalo of Ceylon feral and not truly wild.

Size : Morphological characters

Prater gives the size of a large bull at from 5-foot 6-inch at the shoulders to 6-foot 6-inch exceptionally; the later figure seems

improbably tall, for the buffalo is an exceptionally massive animal, probably broader across the body than any other Indian mammal in proportion to its height, and inclined to be squat rather than tall when very massive. The weight has been estimated at around a ton, for a big bull.

The Indian wild buffalo is the heaviest and most massive of all wild oxen, and probably the fiercest when truly wild. The horns are characteristically flattened on top and rugose, and somewhat triangular in section; there are two main types of horns, one with the horns semicircular and curving upwards from the head with the tips fairly close to each other (photograph MISC 4-A) and the other type with the horns sweeping out from the head sideways with a shallow curve. Both types of horn may be found in the same herd, as also intermediate types.

Distribution

At present found, within Indian limits, mainly in Assam: a few animals are to be found around the Chitrakunda project, both in Orissa and on the Andhra side of the project, and their fate after the commissioning of the project is unpredictable. A small population is to be found along the river Indravati, in Bastar in Madhya Pradesh.

J. C. Daniel conducted a survey of the buffaloes in the Bastar area early in the sixties. Visiting the areas he went to and a few around in March 1971, towards the end of the month, I found the forest ponds (*tal*) dried up, and only old footprints and dung pats; I was told the buffaloes had been there, but had moved on, and was shown a *tal* at which a bull had been shot on licence the previous year, though the animals are said to be protected. At Balimela in Orissa (around the Chitrakunda Project) I saw fresh slots and dung of small parties, but not the buffaloes themselves, in January 1969.

Habits: Behaviour

Since no wild buffaloes were observed except in Assam (outside the territory of the survey) no notes on habits are provided. However, a threat display staged by the bull of a small herd in the Mihimukh area of the Kaziranga Sanctuary, may be mentioned (MISC 68, Feb. 3). When approached on elephant back, this bull came trotting towards us till about 40 yards away, and then took a bound forward, stopping with a rocking halt by braking the momentum of the bound with braced forefeet: he then returned to the herd, but staged a similar display awhile later.

Above : BIHAR 1970 : BETLA : PALAMAU N.P. : February 26 — about 7.30 p.m. : Chital stag eating bael fruit — B. 35 ; *Below :* BIHAR 1970 : BETLA : PALAMAU N.P. : February 28 — 10.30 a.m. : The limping stag — B. 36.

(*Photos : M. Krishnan*)

Above : MAHARASHTRA 1969 : TAROBA N.P. : November 15 — about 7.30 p.m. : Chital in bamboo cover : Chital Road : MR. 7 ; *Below :* MAHARASHTRA 1969 : TAROBA N.P. : November 16 — about 7 p.m. : stag-party — MR. 8.

(*Photos : M. Krishnan*)

THE CHINKARA

Gazella gazella (Pallas)

(Summary of field notes : Observation records : 5.

Locations : Andhra Pradesh—Kawal Sanctuary ; Bihar—Rehal, Karkatnagar ; Madhya Pradesh—Shivpuri National Park.

No photograph).

During the survey period no visits could be made to the ravine-cut plains jungles inhabited by chinkara, and no special attempt was made to see them except for a brief trip to Karkatnagar via Rehal. The Deccan, where I had seen chinkara prior to 1959, was not visited at all. I saw chinkara twice in Bihar during night drives, mere fleeting glimpses, and had a similar fleeting glimpse of a buck in Shivpuri, also during a night drive. I also saw them twice in the same forest in the Kawal Sanctuary, by day (A.P. 68 November 10 ; B 69 February 27 and March 2 ; MP 69 March 31).

Size : Morphological characters

Prater provides a full account of size and morphological characters.

Distribution

In the Kawal Sanctuary, I saw chinkara in heavier forests (teak forests) than they usually inhabit. The present distribution of the animal, when it has been so severely affected by hunting and is locally extinct in many of its former haunts, needs to be investigated.

THE BLACKBUCK

Antilope cervicapra (Linnaeus)

(Summary of field notes : Observation records : 30.

Locations : Tamil Nadu—Guindy Park, Point Calimere Sa.; Orissa—Bhetnoi near Aska ; Madhya Pradesh—Kanha N.P.

Photographs : TN 50, TN 57, MP 1, MP 39).

This is an animal whose disappearance from the plains forests of the South I have actually watched. In my boyhood it was common in the many stretches of scrub jungle around Madras, in small herds, sometimes in herds of over 50 : except in and around the Raj Bhavan at Guindy, where it is protected, it is now locally extinct in all these areas, and most of them have been reclaimed for agriculture, industrial enterprises, and other human purposes. Blackbuck in fairly large herds were known around the site of the Tungabhadra Project in the forties, but are now extinct there, having been shot out and snared.

Although this is a report which does not concern itself with past faunal history, it is necessary to briefly refer to the sustained massacre of blackbuck that has led to its present extinction in many parts of the peninsula, particularly in the Deccan and in South India.

Being an animal of the open plains, the blackbuck was most exposed to every form of hunting by every kind of hunter, for its haunts were often close to cantonments and barracks, small towns, and rural settlements. Everyone who has handled a gun in India within the past two centuries has probably shot blackbuck, for it was the commonest ' game ' animal and an animal whose hunting resulted both in a trophy (as often the skin of the doe as the horns of the buck) and in much-fancied meat. When sustained shooting made the buck wary of men, the hunters stalked their quarry under cover of a bullock cart, and later shot it from motor vehicles. Thousands of buck were shot every year, and more, perhaps, wounded. No Indian animal has suffered more at the hands of sportsmen.

When cultivation spread to the open scrub, an additional reason was found for shooting buck, as crop-raiders. Nor was the hunting of these animals limited to those with guns. Professional meat-hunters, using snares and similar devices, have probably accounted for more buck even than sportsmen. In fact, in the Tungabhadra area, it was the snare rather than the gun that finished off the local buck.

Nooses with slip-knots, usually made from the dried and stretched Achilles tendon of buck, were set staked to the ground in patches of the wild bitter-gourd, the fruit of which is greatly fancied by buck, and the animals caught by a foot were killed hours, may be even days, later. A specially cruel and effective means employed to immobilise blackbuck, practised all over the northern half of its range in the peninsula, is to insert a very sharp iron hook, something like a giant fish-hook, skilfully through the mark left by the stalk of a ripe bael fruit, so that it is entirely buried in the pulp within ; a thin, tough string, about 8 inches long, is attached at one end to this hook and the other end is tied to the middle of a sliver of hard-wood, shaped somewhat like a pencil and about the same length—the pencil and string are outside the fruit and the hook within. The bait is then left on the ground in areas known to be frequented by buck. The buck picks up the ripe fruit in its mouth and bites hard to get through the rind to the pulp within : this drives the point of the hook into its palate or the inside of a cheek, and instantly it paws at the pencil and string hanging out of its mouth with a forefoot, to get rid of the fruit which it cannot just spit out : this results in the pencil getting firmly lodged in the cleft between the hooves of the forefoot, and when this happens the devilish contraption succeeds in completely immobilising the animal, for every movement of the foot only drives the hook deeper in, and caught by its forefoot held to the mouth, it cannot use its muzzle to dislodge the sliver of wood from between

Above : MYSORE 1968 : BANDIPUR SA. : October 8 — a.m. : Chital drinking — Baisanapur Keré — MY. 1 ; *Below :* MYSORE 1968 : BANDIPUR SA. : October 8 — a.m. : Chital eating tree foliage (*Emblica* sp.) — MY. 2.

(*Photos : M. Krishnan*)

Above : MYSORE 1968 : BANDIPUR SA. : October 11 — p.m., towards sunset : Chital drinking at Sullukatté — MY. 8 ; *Below :* MYSORE 1968 : BANDIPUR SA. : October 23 — a.m. : stags in velvet and in hard horn — MY. 12.

(*Photos : M. Krishnan*)

the cleft in its hoof. It falls helpless to the ground, and then the hunter comes round in the course of his inspection of the grounds he has baited, and kills it.

Blackbuck are now extinct in most of the places where they were well known only 40 years ago, especially in the middle and south of the peninsula.

Long known to humanity in the plains, and notable for their beauty, grace and speed, blackbuck have separate names for the male and the female in most Indian languages. In Tamil, for instance, blackbuck are termed 'kalai-maan' generally, and the buck is termed 'kalai' and the doe 'pulvaai': Prater is at fault for once in giving some new-fangled Tamil name for blackbuck which seeks to distinguish between antelope and deer, a distinction that does not obtain in Indian languages.

Size: Morphological characters

Blackbuck are said to attain their best development in north India, in Rajputana and the Punjab. They are definitely smaller in size in the south-eastern part of the peninsula than in the central and north-western areas. The male is larger than the female and a big buck stands 32 inches high and weighs around 90 lb (Prater). Prater is incorrect in saying that in South India the adult buck are usually not black but a deep brown. In South India, too, the adult buck are a rich black as a rule, but a few adult males may remain a dark, grizzled colour.

The dark colour of the adult buck is notable, for it is largely diurnal and often lies up in the open during the hottest part of the day (MP 69 March 10).

Distribution

This exclusively Indian and prettiest of all antelopes had an all-India distribution in the plains till comparatively recently, inhabiting even the drier and more open scrub where many other animals with an all-India distribution (like the chital and the sloth bear) are not to be found. Being so heavily and systematically hunted, it has become locally extinct in most of its former haunts and its present distribution is scattered and in need of reassessment. It is now extinct in many of the black-cotton-soil tracts of the Deccan where formerly it was abundant, and also in most of its former haunts elsewhere in the peninsula. It inhabits coastal plains, along the eastern coastline, such as around Chilka Lake, Madras City and Point Calimere, but it is not to be found along the western coastline. It is basically an animal of the drier and more open plains scrub, and deprivation of territory by human occupation of its home has contributed as much as the gun or the snare to its decline.

Although man has been probably the most potent influence in the decline of blackbuck, it is significant that two of the major natural predators that used to inhabit its haunts along with it, the cheetah and the plains wolf, have both become extinct (the cheetah totally and the wolf locally) in those areas even ahead of the blackbuck.

Blackbuck do not inhabit dense forests or hilly country. An isolated population existed, or still survives in small numbers, immediately outside the Masinagudi area of the Mudumalai Sanctuary, on the north-eastern slopes of the Nilgiris where they flatten out into plains country.

Habits : Behaviour

It is noteworthy that in Bhetnoi near Aska in Orissa, rural sentiment has protected blackbuck for generations, although this is mainly an agricultural village. Inquiry of the villagers elicited the information that loss to crops from blackbuck was negligible : in Point Calimere, too, I was told that it was the pig and the chital that inhibited agriculture and not blackbuck. These instances will show to what extent a taste for buck-flesh lay behind the killing of blackbuck as crop-raiders all over India.

Besides short grasses and herbs, blackbuck eat a variety of creepers that spread along the ground in patches (such as *Ipomoea* spp.) and eat the foliage and fruits of many plants of the Cucurbitaceae. I have seen, necessarily from a great distance and through glasses, blackbuck scraping at soft soil with their forefeet and muzzle to get at the underground parts of some plant, and believe stolons, rhizomes and bulbs are also eaten. They drink regularly where water is available, as at Guindy Park, but seem to be able to do with little water where freshwater is scarce, as around Chilka Lake and at Point Calimere in summer.

Vision is the chief sense, and is very keen. Blackbuck have good night vision (TN 68 June 8) and are often abroad and feeding at night (MP 69 March 10, 70 March 12). However, they are mainly diurnal, and creatures of the sun. At night they lie down in groups in open ground where they cannot be surprised from cover, and piles of their droppings mark such resting places.

Blackbuck are the fastest long-distance runners in the world. Their habit of taking a few stiff-legged vertical leaps at the start of a run is well-known, and probably serves to enable them to see the country ahead before settling down to a bounding gallop. Once, I was in a motor vehicle kept going at top speed over very flat ground, and a herd of blackbuck kept easily ahead of us though we were going at about 40 mph, at times at 45 mph : after 3 miles we had to slow down as the ground became somewhat uneven, and the buck raced on ahead.

Jackals seem to be the chief predators that blackbuck have to contend with today. They take newborn and very young animals. These very

Above : MYSORE 1968 : BANDIPUR SA : October 23 — a m : Stags thrashing bushes — MY. 13 ; *Below :* MYSORE 1968 : BANDIPUR SA. : October 24 — a.m. : The stag and hind that were together in a pair — MY. 14.

(*Photos : M. Krishnan*)

Above : MYSORE 1968 : BANDIPUR SA. : October 25 — a.m. : Chital crossing a maidan — MY. 15 ; *Below :* MYSORE 1968 : BANDIPUR SA. : October 26 — 8.30 a.m. : Stag with long antlers in velvet — MY. 18.

(*Photos : M. Krishnan*)

young blackbuck are given to crouching, neck stretched in front (like barasingha) when approached : the mothers run away.

THE FOURHORNED ANTELOPE or CHOWSINGHA

Tetracerus quadricornis (Blainville)

(Summary of field notes : Observation records : 4.
Locations : Tamil Nadu—Mudumalai Sanctuary near Markundarai Betta ; Andhra Pradesh—Pakhal Sanctuary ; Bihar—Hazaribagh N.P.
No photograph).

The chowsingha, small-sized, localised, largely nocturnal and given to lurking in the undershrub of the forests it favours, was probably missed much oftener than seen during the survey period. It is one of those animals that one gets to know when residing in the area it inhabits, rather than during brief visits to such areas, and I know it well.

Size : Morphological characters

The chowsingha is roughly the size of a muntjac or a chinkara, about 26 inches high and weighing around 50 lb. The coarse, furry coat has a greyish tinge to its brown, distinct from the chestnut sheen of the muntjac, and it does not have the dishface and prominent black tail of the chinkara, but nevertheless, occurring as it does in forests where both these other animals are found, it is often mistaken for one of them, especially as colours are not clearly appreciated at night by artificial light.

This animal, which differs in certain anatomical particulars from other (true) antelopes, has more the habits of forest living deer than of antelopes, and is unique is being the only wild animal in the world with four horns : the does are hornless, but in the male, in addition to a pair of keeled spike horns on top of the head (where horns are normally located in antelopes) there is a pair of small horns just below, above the forehead, often reduced to mere horny buttons. Its nearest relatives are to be found in Africa.

Distribution

The chowsingha is uniquely Indian, and confined to peninsular India, somewhat capriciously distributed within this vast area in hilly tracts—it favours hilltops, particularly plateaus, and foothills, where there is plenty of grass and an assured supply of water : it is a thirsty animal and drinks regularly.

Habits : Behaviour

The chowsingha is usually seen by itself or in a pair, but occasionally in a party of from 3 to 5 or 6 (B 68 April 17). I saw the animal in April

1968 in the Hazaribagh National Park, but not in February 1969 and February 1970, though I kept a sharp lookout for it in both years. It could be the chowsingha shifts ground with the onset of summer, but they also seem, like muntjac, to remain more or less in the same forest area.

The chowsingha has quite exceptional leaping abilities.

THE NILGAI

Boselaphus tragocamelus (Pallas)

(Summary of field notes: Observation records: 12.

Locations: Andhra Pradesh—Eturnagaram Sa.; Maharashtra—Taroba N.P.; Bihar—Hazaribagh N.P.; Madhya Pradesh—Shivpuri N.P., near Mukhavlei, Bastar.

Photographs: MP 24, B 30).

Areas where nilgai are fairly common in Bihar and Madhya Pradesh were not visited during the survey period. No sustained observation was possible, all sight records being limited to fleeting or less fleeting glimpses, usually from a distance. A determined effort to observe or at least sight nilgai in the Kawal Sanctuary was unsuccessful (A.P. 68 November 7 to 11). Nilgai were seen, singly, in Eturnagaram and Taroba N.P. (A.P. 68 January 16; MR 68 November 18, 20; 69 November 17). A small herd of about 6, including a big bull was frequenting the sandy nullah near Pokharia gate in the Hazaribagh N.P., and some members of this party were seen thrice (B 69 February 8 and 14, 70 February 15 : photograph B 30) : nilgai seem fairly common in the Shivpuri N.P. of M.P. (MP 69 March 31 : photograph MP 24, April 3 and 4), and a party of 3 adult cows was seen in Bastar (MP 70 March 27). They were seen both by night and by day.

In view of the paucity of personal experience of nilgai, a note on it here is not justified. However, I may add that the description and depiction of the animal as having a short tail with a thick, black terminal tuft of hair is not quite correct. The short tail is dorso-ventrally flattened and the black hair grows thickly along the edges of the terminal third of the tail, forming a brush : the tail is raised vertically above the back under excitement.

THE HARDGROUND BARASINGHA

Cervus duvauceli branderi (Pocock)

(Summary of field notes : Observation records : 45.

Locations : Madhya Pradesh—Kanha National Park.

Photographs : MP 2, MP 13, MP 14, MP 19, MP 20, MP 21, MP 22, MP 27, MP 28, MP 31, MP 32, and MP 36).

The vulgar name provided here may be briefly explained. Since the name ' barasingha ' is also applied to the Kashmir stag or hangul, it may seem advisable to prefer the name ' swamp deer ' for both subspecies of *Cervus duvauceli*, as Prater has done. The name, while eminently applicable to the subspecies inhabiting marshy tracts in Uttar Pradesh and Assam (*C. duvauceli duvauceli*) seems misleading when applied to the subspecies found in Madhya Pradesh, and to qualify ' swamp deer ' with the adjectival ' hardground ' to distinguish *C. duvauceli branderi* is a literal contradiction in terms. Since this report is confined to the peninsula where only this last subspecies is found and where the Kashmir stag is not found, the name ' hardground barasingha ' seems specific and descriptive, and has been used.

Schaller provides an account of a detailed and deep study of this deer in the Kanha National Park (the area in which I observed it), and for this reason only a few observations need be detailed here.

Although smaller than the sambar and with quite distinctive antlers, and larger than the chital and with different antlers, I have known the barasingha confused with both in Kanha. From a distance visual assessment of size is not reliable, especially in open ground. The best way is to aid vision with glasses.

All barasingha seen in Kanha were observed in March 1969 and 70, and early in May 1968, when the stags had not yet shed their antlers here, and had ragged coats, with the hair of the winter coat coming off in matted strips and bunches. Some stags were dark brown in colour, a vandyke brown, but most were only a little darker than the hinds. Four stags lying down in the shade were attended on by crows, which plucked the hair off the neck of two stags in beakfuls, the stags offering no resistance to this attention : the crows were not using the matted hair for nesting, nor did they seem to have any object in indulging in this hair-stripping—they plucked out a beakful of hair, tossed it onto the ground, and then plucked out another beakful. After 7 or 8 beakfuls had been removed in this manner, both the stags tossed their antlers and chased away the crows (MP 70 March 13).

The stags seemed to have developed a certain brittleness of horn by March, about 2 months before shedding their antlers (late May-June). One stag had the right brow tine broken off clean at the base, where it joined the beam, a flat, oval, bone-white scar marking the cleavage

(MP 69 Mar. 13 : photograph MP 21) : another stag broke off a tine from the rack on top of the beam in between March 17 and 22, 1970, and had a similar flat, white, oval cleavage mark at the joint of the tine with the beam (MP 70 Mar. 23).

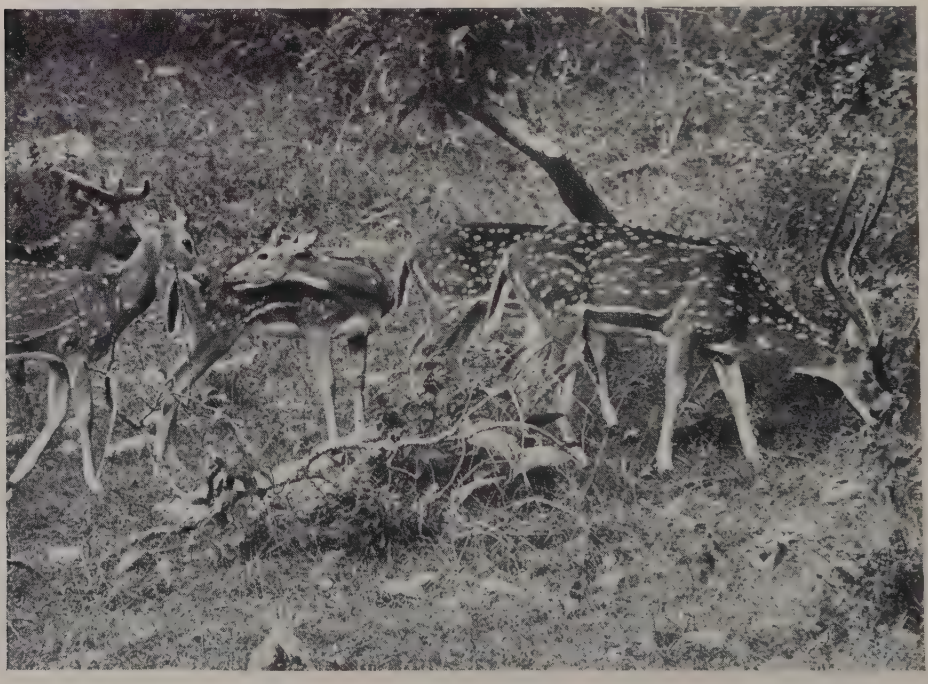
Although by March the breeding season is said to be over, one stag was seen displaying sexual interest in a hind, smelling at her hindquarters and smelling her urine and curling up the lips with the muzzle pointing up. No bugling was heard.

In March 1970 two big stags, not seen during previous visits to Kanha (in May 1968 and March 1969) were noticed. One was a 12-pointer with a coat only a little darker than a hind's and with well-developed antlers of the typical barasingha pattern, with the tines bone-white for their distal half : the other was a remarkable specimen, a little smaller in the body than the 12-pointer but sturdily built and dark brown, with rugged antlers, heavy enough and sufficiently beaded to have been notable on a sambar stag : the beam was rather straight, and the rack of tines on top numerous on somewhat palmate forks—the many snags made counting the total number of points difficult, though on several occasions he was closely observed, the difficulty being in determining what was a tine and what a mere burr or small snag : however, by any count this multipointer had upwards of 20 points (MP 70 Mar. 8, 12, 13, 19, 21, 22, 23 : photographs MP 27, MP 31 and MP 32—there are several other pictures of this multipointer taken to show his antlers from different angles in big blow-ups, which could not be included here because the details are not clear in small prints).

This multipointer was usually seen in the company of the big 12-pointer and sometimes along with two fully adult but lesser stags, a fine 10-pointer and a small, back-going 12-pointer, in a small stag-party of 4, and also in a herd with hinds, brockets, and young. The multipointer was obviously the most dominant stag in Kanha in March 1970 : the big 12-pointer took precedence after him, then the 10-pointer, then the 12-pointer : photograph MP 32 shows all the 4 stags together. No sparring between these stags was noticed, but once the two lesser stags locked horns for a few seconds in a desultory, brief bout of sparring. The head-up display was used by the two larger stags, towards the other two, and by the multipointer towards the big 12-pointer. It was noticed that when on the move both the big stags used a threat with the antlers lowered to direct a lesser stag in the lead. What can only be described as a sideway's glare was also used as a threat or direction : in chital, such ocular displays are common. Among hinds, too, the head-up display was freely used (MP 69 Mar. 16 : photograph MP 19), but no head-down display (used by chital and sambar stags in intimidation) was observed. Two hinds indulged in a mutual head-up display which was developed into their rising in the air on their hind legs and slashing

Above : MYSORE 1968 : BANDIPUR SA. : October 6 — 10 p.m. : Chital around the rest-house — MY. 20 ; *Below :* MYSORE 1969 : BANDIPUR SA. : October 9 — 5 p.m. : Chital grazing tall grass — MY. 21.

(*Photos : M. Krishnan*)



Above : MYSORE 1969 : BANDIPUR SA. : October 14 — 4.10 p.m. : Part of the herd crossing a clearing — MY. 24 ; *Below :* MYSORE 1969 : BANDIPUR SA. : October 14 — p.m. : A brocket biting at his flank. Note attitude of brocket just behind him — MY. 25.

(*Photos : M. Krishnan*)

at each other with their forelegs (MP 69 Mar. 19 : photograph MP 22).

On occasion barasingha were heard indulging in their hysterical, baying alarm, sustained over several minutes (MP 68 May 3, 69 Mar. 7 & 8) : perhaps a tiger was the cause of the excitment, the chorus of many deer baying sharply developing into a frenzied crescendo of short, high-pitched yappings : on the latter two occasions, towards the end of the baying of the barasingha, the sharp alarm calls of chital were heard in accompaniment.

Barasingha hinds indulge in a 'conversation' with one another, very much in the manner of chital hinds in a herd when in cover, but less fluently and with less variation to their mewling call. This call is a soft, long-drawn, plaintive mewling sound, not audible from a distance, and not broken up into syllables but modulated—a long 'Chchaaai' ending on a thin, querulous note. A herd of 13 barasingha split into two parties, one of 6 and one of 7 : later, the oldest hind in the party of 7 which was grazing in a nullah, came out of the nullah and crossed the open ground beyond, coming out with repeated mewling calls : 2 hinds (probably belonging to the party of 6) came up across a rise towards her, also coming out with this mewling call : the leading newcomer came up to the old hind with neck outstretched and sniffed at the head of the older hind who, thereupon, rose on her hindlegs and pawed the air right in front of the newcomer's nose with her forefeet, in what was evidently a threat. The newcomer backed a step but maintained the stretched-neck attitude which, evidently, was submissive or placatory, and then the 2 new hinds joined the party of 7 (MP 69 Mar. 16). Once I had a quite exceptional opportunity to listen to the mewling intraspecific calls of barasingha and chital at the same time and from the same spot, both the deer being equidistant from me, about 50 yards away : the barasingha's mewling call was softer, less varied and less audible (MP 70 March 21).

A mother and her young fawn (about 6 months old or younger) were observed licking each other (photograph MP 28).

Parties and herds were observed lying up in the tall grass of a nullah, some standing and some lying down : herds also lay down in an open maidan when it was cloudy and not too hot : at night the barasingha were seen lying up in the grass close together, in a herd (MP 70 Mar. 7, 8, 19 and 23: photographs MP 27 and MP 36). A large herd was seen in the water at Sravantal (MP Mar. 8).

A sharp lookout was kept for stag parties, but though several such parties were seen, none was large : no stag parties of over 10 animals or so were seen, and even in Assam where I saw larger stag parties (of *Cervus duvauceli duvauceli*, in the Kaziranga Sa.) nothing like the large stag parties of chital seen in the Masinagudi area of the Mudumalai Sa. was noticed. The largest congregations were mixed herds. consisting

mainly of adult hinds, with a few fawns, a few yearlings, and a very few adult stags or only a few brockets : herds of about 50 (1 adult and 2 young stags), 33 (no adult male), 47 (one dark adult stag, 2 younger stags, 3 brockets, 9 animals well under one year, rest hinds), and 32 (mainly adult hinds, no adult stag) were seen (MP 68 May 1, 68 May 5, 69 Mar. 8, 70 Mar. 17: photographs MP 2, MP 13).

The most striking characteristic of the barasingha seen in Kanha was their lassitude, as compared to other (marshland) barasingha seen in U.P. and Assam. No doubt at Kanha they are used to the sight of men, and because of this, and also because of the general tendency of animals to permit a close approach when men are in a motor vehicle or on elephant back (and not on foot), they permit one to get quite close, but making allowance for all this, I was still struck by their lassitude, and did not think it merely familiarity with men—in this connection, it is worth remembering that the barasingha at Kanha do not stay in the meadow round the year, and that they come in from all round and that Schaller thinks poaching is partly responsible for the decline in their numbers—it is my experience that animals hunted or harassed are never unduly trustful of men. Schaller thought the high mortality among infants he noticed was probably due to brucellosis, and it could well be the lack of wariness and vivacity I noticed was also caused by the debilitating effects of the infection.

The population evaluations of barasingha at Kanha park are based on the deer visiting the meadow during summer. The deer seem to arrive here from many places around, and although the population in the meadow substantially represents the total population in and around the park, a few may go elsewhere (to places not known at present) ; the arrival of the multipointer at Kanha in March 1970, when he was not there in 68 and 69 suggests this, *if* the antlers he carried in 1970 were representative of those he carried in 1968 and 69. Anyway, the survival of the hardground subspecies of barasingha is dependent almost entirely on the deer in Kanha : the isolated small herds, parties or individuals known elsewhere, as at Bastar, have small chance of survival.

Schaller thought the Kanha population totalled around 50, and that the official figures (about 100) were rather high. That may have been so for the 2 years he studied the deer here. I watched the census being taken and thought the official *modus operandi* somewhat haphazard : for example, it completely missed a herd of 19 I was watching in a nullah that day (MP 70 Mar. 7). Even if, as I think, there are about 100 animals left in Kanha today, there is little room for complacency in this number. There were several hundreds here only a few decades ago and thousands earlier, and these undoubtedly represent the last stable population of hardground barasingha anywhere. Various causes for the decline of the deer at Kanha have already been mentioned. I think (I realise that

Above : MYSORE 1969 : BANDIPUR SA. : October 14 — p.m. : 3 young stags sparring — MY. 26 ; *Below :* MYSORE 1969 : BANDIPUR SA. : October 14 — p.m. : The biggest stag in the head (same as stag photographed reclining Oct. 22 a.m.) — MY. 27.

(*Photos : M. Krishnan*)

Above : MYSORE 1969 : BANDIPUR SA. : October 22 — 8.30 a.m. : Chital at rest — MY. 28 ; *Below :* MYSORE 1969 : BANDIPUR SA. : October 22 — a.m. : The big stag reclining (same stag photographed Oct. 14 — p.m.) — MY. 29.

(*Photos : M. Krishnan*)

others differ from me over this) that the artificial attraction of tigers to the Kanha meadow has definitely resulted both in the decline of the barasingha and in the decline of the tiger in this park. Whether or not this is true, everyone agrees that unless immediate steps are taken to save this particular subspecies of the barasingha, it will inevitably become extinct. A plan based on capture and release into a large stockade of a few animals, to be protected and studied, is being carried out. In 1968 I suggested a scheme for introducing fresh blood, from the marshland subspecies of U.P. : my scheme, based on genetical factors and the experience of breeders of pedigreed dogs and other domestic animals (whose breeds differ much more in physical characteristics than the 2 subspecies of the barasingha do) is probably difficult of operation. Anyway it is not being pursued. With the position of the hardground barasingha so precarious, it was heartening to note a distinct improvement in the fawn and yearling ratio to adults in 1970. Whether or not this improvement will be maintained is something that only time can tell.

I do not know on what taxonomical grounds the genus *Cervus* is distinguished from the genus *Axis*, but think that barasingha in Kanha show a much greater affinity to chital than to sambar : till recently sambar too, were not included in the genus *Cervus*, but at one time it was suspected that barasingha and sambar interbred occasionally. I think that if barasingha interbreed with other deer, it is more likely to be with chital, not in the wild, but in captivity.

THE SAMBAR

Cervus unicolor Kerr

(Summary of field notes: Observation records : 200 +.

Locations: Kerala—Periyar Sa.; Tamil Nadu—Mudumalai Sa.; Mysore—Bandipur Sa.; Andhra Pradesh—Kawal Sa.; Orissa—Raigoda Sa., Usha Kothi Sa.; Bihar—Hazaribagh N.P., Palamau N.P., Tholkobad, Karkatnagar; Madhya Pradesh—Churna, Shivpuri N.P., Kanha N. P.: Maharashtra—Taroba N.P.

Photographs: K 8: TN 2, TN 8, TN 12, TN 14, TN 26, TN 35, TN 44, TN 45 and TN 59: B 6, B 7, B 8, B 22, B 24, B 25, B 26, B 27, B 28 and B 29: MP 34: MR 10 and MR 13).

The sambar was one of the very few animals seen in all the 8 States in which the survey was conducted, and it was also observed outside the survey areas. The opportunity to study it in so many diverse locations was rewarding. Although a typical forest deer, also found in hilly tracts where there are extensive belts of tall grass, it does not favour dense tree growth and is essentially a creature of the more open deciduous forests, and is found even in dry forests with little tree shade in summer. It is much more diurnal in its habits than is generally realised though it does forage by night as well, and where it is not disturbed by

men is commonly abroad by day. Its tolerance of the sun and heat are remarkable. Since this account is based largely on field observations (supplemented by photographs), in order to avoid needless length much of the information available on sambar in faunal literature (such as an account of its distribution) is not repeated here, but necessary references are specifically cited.

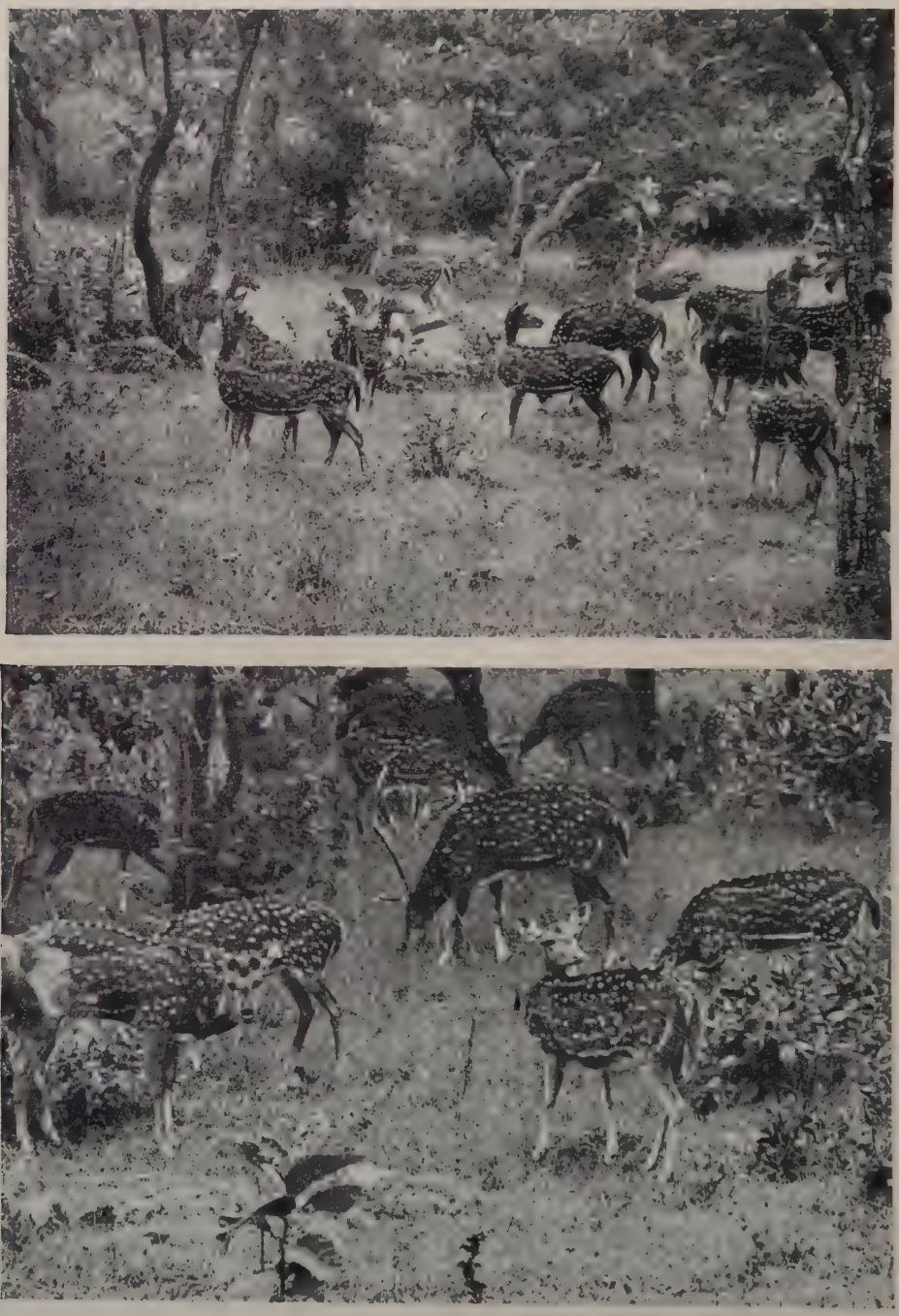
Size : Morphological characters

Size varies considerably with locality and strain, but the sambar is definitely the largest of all Asiatic deer and seems to attain its best development in India. Stags are taller than hinds and usually much heavier : a very big stag may stand some 56 inches high and weigh 700 lb, a small adult stag only 48 inches in height, and 450 lb in weight, or even less. There is no direct correlation in stags between body size and antler development : some very big stags may carry comparatively poor antlers, and some medium-sized ones exceptionally well-developed antlers. There is a distinct trend towards small body size in the drier and more open forests, especially those in the plains, and generally speaking sambar are smaller in the southern parts of the peninsula than in the northern parts. The most magnificent body development seems to be attained in the north-western areas of Orissa, on the Bihar border, and in Bihar near that border and in certain other areas such as Hazaribagh, and some stags of the most impressive size were seen in Badrama, Singhbhum, and Hazaribagh (O 69 Jan. 27; B 69 Feb. 4 and 5/6, 68 Apr. 17, 68 Feb. 12, 70 Feb. 2 and 13) ; a peculiarity of these big stags is the robust development of the brow tine—though the antlers may not be notably long, they are heavy and well-beaded in the beam and the brow tines are notably long and heavy (O 70 Jan. 25; B 68 Apr. 17 and 70 Feb. 12 : photographs B 24 and B 29). A mounted head at the rest-house at the Usha Kothi Sanctuary (Badrama) was only 33 inches long measured along the curve but very thick and with the brow tines heavy and fully 16 inches long : another mounted head at the Forest Training College in Champua, near the Bihar border, was 40 inches around the curve from base to tip of the outer tine of the beam and the brow tines were 18 inches long : a comparison of the length of these with those of antlers from other parts of India shows that in parts in Madhya Pradesh an equally notable development of the brow tines is seen in exceptionally thick antlers (Dunbar Brander) but not in other areas, and that in many antlers notable for their length (Forsyth's record head, for example) the brow tines are comparatively much shorter ; in other parts of the peninsula, the brow tines do not seem to be developed to this extent. Note that both photographs B 24 and B 29 show antlers notable only for their brow tines, and otherwise of modest length.

It is generally said that old stags are very dark, almost black. Where the winter and summer coats are notably different (as they are not in

Above : MYSORE 1969 : BANDIPUR SA. : October 22 — a.m. : The light-coloured stag with short brow-tines — MY. 30 ; *Below :* MYSORE 1969 : BANDIPUR SA. : October 22 — a.m. : Short-brow-tine running from the big stag without any demonstration by the latter — MY. 31.

(*Photos : M. Krishnan*)



Above : MYSORE 1969 : BANDIPUR SA. : October 23 — a.m. : Chital turning to look in direction of peacock's alarm call — MY. 32 ; *Below :* MYSORE 1969 : BANDIPUR SA.: October 23 — a.m. : Hind looking at me — MY. 33.

(*Photos : M. Krishnan*)

the southern areas of the peninsula) the winter coat is usually much darker, but not always so. I have seen many old stags, even in winter coat, whose pelage was not specially dark, and some whose pelage was somewhat light, being tinged with pale raw umber. The large, obovate ears have much less hair on their insides than in barasingha or chital, and are not conspicuously white on the insides as the ears of those two deer are. There is no white on a sambar, but on the rump and the insides of the legs, especially where they join the body, and on the chin, the hair is usually much paler, a light, warm sienna or even pale ochre. The dorsal aspect of the tail is always black or a very dark blackish brown. In spite of their strong build, quite burly in adult stags, sambar are the most graceful of all deer in their movements, and run swiftly over uneven ground with surefooted ease.

Perhaps the most remarkable feature of the sambar is the wide prevalence of the sore patch in adults, a raw, red patch devoid of hair, at the base of the throat, not found in any other deer : this has been termed ' sore spot ' by most writers, but is termed ' sore patch ' here as the sore is not a spot but much more a patch covering the base of the throat and extending up the neck on either side when extensive. The patch is always ventral and median and usually situated at the base of the throat, though it may start as a thin vertical line of rawness a little higher up—as Dunbar Brander points out, there is a prominent whorl of hair at the throat (clearly shown in photographs B 7, B 8 and B 25—though in the sambar shown there is no sore patch) where the sore patch is situated, the whorl disappearing with the formation and spread of the ' sore '. The patch varies in size from about 2 to 10 inches in diameter, and is usually shield-shaped : in all but incipient or undeveloped sore patches, there is a white-mouthed tubercle placed below the centre, and the skin around is bare of hair and extravasated, a flesh-tint to red in colour : sometimes there is blood on the sore patch, and it is usually coated by a thin, serous exudation, which shows up when the light is strong on the patch—the sore patch is not a dry, angry-looking area of skin (TN 66 Apr. 9 : photograph TN 44). I have never seen the patch on a fawn and not often on a yearling. The sore patch is not a universal feature of sambar everywhere in the peninsula—it does not seem to occur among sambar in the Hazaribagh National Park, a faunal area specially noted for its sambar : I did not see a single sambar in the Taroba N.P. which exhibited a sore patch, in November 1968 and November 1969. In the Kanha N.P., the patch does not seem to be as extensive as it is in other parts of the peninsula, for example the Mudumalai and Bandipur sanctuaries. In the Mudumalai sanctuary, most of the adults (but not all) seen in March, April, September and October carried the sore patch.

From time to time theories have been advanced to explain the sore patch, some of them diverting. Schaller mentions most of these theories,

but not what may be termed the Abrasion Theory, i.e., the theory that the sore patch is the result of the skin at the base of the throat getting abraded in the course of the sambar's passage through hard or spiky undershrub—this theory ignores the fact that sambar living in areas where the undershrub is not hard also show the sore patch and that the 'sore' is invariably located at the same spot, and is on the ventral median line of the throat and perfectly symmetrical. Schaller himself thinks that the sore patch has a sexual significance, the exudation from it being rubbed off on the vegetation to provide scent markings in the course of the sambar's movements through cover : in fact, he argues a different breeding season for sambar in the Kaziranga Sanctuary and the Kanha N.P. on the basis of the different months in which the animals with sore patches are seen in both sanctuaries, and says that in Kanha the patch is seen invariably on adults in November-December, and only from mid-November to mid-December. I saw the vertical commencement of the sore patch on the necks of 2 adult hinds at Sravantal lick (in Kanha) in March (MP 70 Mar. 17 : photograph MP 34 : the flash picture clearly shows the medium vertical incipient sore patches on both hinds). Further, I do not think the sore patch has any sexual significance. I have seen it on hinds with very young fawns at their heels, when they were still in the phase of lactation and could not have been in breeding condition (TN 62 Mar. 21 : photograph TN 12, TN 62 Mar. 24, Apr. 7, 66 Apr. 1 and 2), and also on a heavily gravid hind (TN 62 Mar. 24: photograph TN 14 shows the extensive sore patch), and also on stags in velvet (TN 66 Apr. 4)—quite adequate evidence of the sore patch having no sexual significance.

I agree with those that suggest a glandular basis for the patch : its location and the white-lipped mouth of the patch does suggest some glandular activity. Clearly it is nothing pathological, but normal, considering the commonness of its occurrence. Inquiry made at Hazaribagh N.P. elicited the information that at no time were sambar with flagrant sore patches seen—even outside the months of February and April when I worked in the sanctuary. Sore patches were seen in Singhbhum early in February (B 69 Feb. 5/6) and in Kanha N.P. in March.

The truth seems to be that although the sore patch is such a flagrant and remarkable feature, and uniquely confined to sambar among deer (or, for that matter, among all mammals) no work to determine its histogenesis or even periodicity has been done : seeing that sambar in confinement (as in zoos) also develop the sore patch, scrapings from the sore and biopsy should be helpful in determining its true nature.

Habits : Behaviour

Sambar vary widely in their habits and responses, being such versatile animals. However, Prater's statement that they 'retire into heavy cover at daybreak and do not usually come out till dusk' is based entirely

Above : TAMIL NADU 1962 : MUDUMALAI SA. : Masinagudi : September 23 — 6 p.m. : Chital on the hill — TN. 21 ; *Below :* TAMIL NADU 1963 : MUDUMALAI SA. : Kargudi : April 2 — a.m. : Pair of Chital hinds reacting to a whistle and its echo — TN. 25.

(*Photos : M. Krishnan*)

Above : TAMIL NADU 1964 : MUDUMALAI SA. : Masinagudi : October 4 — 6 a.m. : Stag-party of chital in the plantation — TN. 41 ; *Below :* TAMIL NADU 1964 : MUDUMALAI SA. : Kargudi : October 6 — p.m. : The party of chital in the timber yard ; stag following hind — TN. 42.

(*Photos : M. Krishnan*)

on the evidence of hunters to avoid whom the animals have turned nocturnal and crepuscular, and is not true : compelling evidence on this point is offered by my field notes and photographs, but to avoid needless length I am not referring to the hundred and odd occasions on which I have watched sambar by day, but am merely citing the photographs showing sambar going about their normal activities by day, in the morning, in the forenoon and in the afternoon (photographs TN 2, TN 8, TN 12, TN 26, TN 35, TN 45, and TN 59—there are dozens of other photographs, not reproduced here, showing sambar feeding or relaxing in the open, by broad daylight).

Sambar are much less gregarious than chital or barasingha, and are often seen alone, especially the stags, or in family groups of a fawn and its mother, sometimes accompanied by a yearling, evidently the adult hind's young from the previous year (TN 59 Mar. 9, Mar. 15, 62 Mar. 13, Mar. 21, 64 Mar. 19) : 2 or 3 adult stags may also be seen together (TN 63 Mar. 26, 64 Mar. 19, 66 Sep. 18) : or the deer may be seen in parties of from 4 to 8, which may or may not include an adult stag and one or two young. The largest congregation I have seen was a herd of 15 (TN 64 Mar. 23), but H. Subba Rao, the knowledgeable Range Officer of the Bandipur Sanctuary told me in October 1968 that he had be seen sambar in herds of over 20 on a hill on the outskirts of the sanctuary.

A feature of the deer is that when a small party is disturbed but not alarmed, and is followed cautiously at a distance, it very often leads to another small group, and that the two join and proceed to yet another group or individual, gaining strength in this manner till a dozen or so are together, when they usually bolt. (TN 59 Mar. 12, 66 Mar. 31, 66 Apr. 3). Hinds with young fawns cache their young in tall grass, but when not alarmed and moving away go up to them and nuzzle them to get them to follow (TN 66 Apr. 7).

Sight is acute, and the ability to see small movements and even to make out stationary objects is good. I have never been able to get close to sambar by stalking them prone over open ground when the wind was in my favour, though chital can be approached in this manner. The sense of hearing is also acute, the animal being able to distinguish between normal and suspicious sounds (TN 63 Apr. 3 : photograph TN 26). Smell, of course, is the paramount sense. Sambar do not wait for visual confirmation when alarmed by scent, but when not unduly alarmed may seek it (TN 63 Mar. 17, 66 Apr. 14). During heavy rain they are evidently unable to scent and hear possible danger, and are, naturally not able to see things clearly either : at such times they stand immobile in the open instead of seeking cover (TN 62 Mar. 21, 66 Sep. 26).

The alarm call, an explosive ' dhank! ', is sounded when the animals are sure of their ground and getaway, a forefoot being also stamped repeatedly (TN 66 Sep. 26; B 70 Feb. 17 and 24).

Leadership in a party is not necessarily determined by the criterion of which animal is in the lead. More often than not, as in most deer and even in gaur, the dominant member of the party stays more or less to the middle and directs a younger, subordinate animal to take the desired line. A bite-threat is commonly employed for this purpose, the dominant sambar moving forward towards the subordinate member of the party with the mouth held menacingly open—the general attitude of the threatening animal is also menacing (TN 64 Mar. 19, 66 Apr. 10). Once a chital hind was seen in association with a sambar hind and fawn which had, on a previous occasion, permitted a close approach on elephant back, but because the chital was apprehensive and bolted at the least move on our part (chital are apprehensive of men on elephant back and even of elephants, much more so than most other animals) the sambar also bolted with their 'guide' (TN 59 Mar. 17).

Sambar lie up in company, choosing open ground for this. The amount of heat they can stand is astonishing. They do not seem much bothered by forest fires, and a hind (with a fawn) was seen standing by freshly charred ground watching unconcernedly a forest fire close by (TN 59 Mar. 15 : photograph TN 2). A party of 7 (3 adult hinds, 3 near-adult hinds and a brocket) lay down in a close group on open, charred ground directly in the afternoon sun, whose heat was oppressive (TN 64 Mar. 26). During forest fires in summer, sometimes it happens that a dead, fallen tree gets set alight, and thereafter for weeks the fire may keep smouldering in the heart of the bole, burning it out to the periphery, leaving a long, conspicuous trail of white ash (marking the burning of the tree) on the forest floor till the heavy rains wash away the ash. I had long known that sambar liked to lie down close to such smouldering fallen trees, but was unable to secure proof till 1964. In 1964, a party of sambar toasting itself close to a long-dead, smouldering *Terminalia tomentosa* was watched over several days and the field notes contain a full record of the observations (TN 64 Apr. 2, 3, 5, 7 : photograph TN 35). The radiated heat by that smouldering tree was oppressive, and the sambar were basking by the fire when the sun itself was scorchingly hot ! Another sambar was seen basking besides a smouldering log two summers later, in a locality far from the scene of the first record (TN 66 Apr. 7).

Dunbar Brander has pointed out that when winter mornings are frosty, sambar lie up in the water, which is warmer—they do so even in the Nilgiris. Apparently they are more sensitive to the cold than to heat.

Sambar are versatile in their feeding, browsing leaves and twigs, eating tree bark, grazing on a variety of herbs (mainly tall grasses) and consuming quantities of forest fruits. After a forest fire, they are probably the first animals to seek out the fresh sprouts of grass—other animals

Above : TAMIL NADU 1969 : MUDUMALAI SA. : Masinagudi : October 3 — 5 p.m. : Chital in the open forest : Jeyadev Ave. — TN. 54 ; *Below :* TAMIL NADU 1969 : MUDUMALAI SA. : Masinagudi : October 4 — p.m. : Chital bolting from wild dogs — TN. 55.

(*Photos : M. Krishnan*)

Above : M.P. 1968 : KANHA N.P. : May 6 — a.m. : Chital stag with widely divergent antlers — M.P. 6 ; *Below :* MYSORE 1969 : BANDIPUR SA. October 24 — about noon : Part of a Chital herd — MY. 34.

(*Photos : M. Krishnan*)

wait till the new grass has sprouted a little higher. (TN 59 Mar. 9). Leaf buds and tender twigs are also choosily eaten, and the foliage and twigs of *Ardisia solanacea* eaten in bulk (TN 66 Apr. 19). The foliage of *Emblica* spp. (much eaten by most herbivores), the foliage and twigs of *Grewia aspera*, *G. hirsuta*. *Hibiscus lampas* (flower also eaten), *Helicteres isora*, the fruits of *Randia dumetorum* and *R. uliginosa*, ber, *Emblica* spp., *Diospyros* spp., and figs are all eaten (TN 62 Mar. 13 : photograph TN 8, 62 Mar. 16, 64 Mar. 19). In the Taroba N.P. sambar were observed feeding on some aquatic sedge or grass and in Bandipur Sa. on *Enteromorpha intestinalis* in a forest pool (MR 68 Nov. 19, 26 : MY 68 Oct. 11).

It is said by all authorities that sambar have a definite breeding season, though this may vary with climatic factors and differ in different regions. The shedding of the antlers seasonally and the birth of young, also in a specific season, are cited as evidence of the existence of a definite breeding season, though these, too, may vary with regional variations and lie in different months in different locations. Regarding the casting off and regeneration of antlers, the evidence available is confusing. Prater says, 'In central and southern India the majority of stags cast their antlers between the end of March and mid-April' and that the new antlers are clear of velvet by November. Taking the Mudumalai Sa., as being representative of the region Prater speaks of, some stags which had just shed their antlers were seen in March-April (TN 63 Mar. 19, Apr. 8) ; many were in hard horn during these 2 months (TN 62 Apr. 6, 63 Mar. 21, Apr. 3 : photograph TN 26): some stags were also seen clearing the velvet from fully formed antlers (TN 63 Mar. 12, 64 Apr. 11, 66 Apr. 7). Further, stags in velvet were seen in September here (TN 63 Sep. 12, 66 Sep. 18). Evidently there is no defined season for the shedding of antlers in this area.

The evidence of birth is much more cogent. Prater, evidently following Dunbar Brander, says 'the young are born at the commencement of the rains, in May or early June'. In the south of the peninsula they appear to be born earlier. A point on which my field notes are consistent in that all very young fawns seen in the Mudumalai Sa. were seen in March, and that the only fawns seen in September-October were juveniles at least 6 months old.

Wallowing, associated in deer with the breeding season, seems to be indulged in at all times in sambar and to have no special sexual connotation. A stag rubbing the velvet off his antlers was observed soon after he had wallowed in a patch of swampy ground (TN 63 Mar. 12), and another with his coat spiky from recent wallowing (TN 66 Apr. 17). A big stag was observed wallowing at the Hazaribagh N.P., at a time when there was no breeding activity (B 70 Feb. 12 : photograph B 28).

THE CHITAL

Axis axis (Erxleben)

(Summary of field notes : Observation records: 300 +.

Locations : Tamil Nadu—Guindy Park, Mudumalai Sa.; Pt. Calimere Sa.; Mysore—Bandipur Sa.; Andhra Pradesh—Eturnagaram Sa.; Orissa—Majhipara, Usha Kothi Sa.; Bihar—Palamau N.P.; Madhya Pradesh—Kanha N.P., Churna, Shivpuri N.P.; Maharashtra—Taroba N.P.

Photographs : TN 21, TN 25, TN 41, TN 42, TN 54 and TN 55: MY 1, MY 2, MY 8, MY 12, MY 13, MY 14, MY 15, MY 18, MY 20, MY 21, MY 24, MY 25, MY 26, MY 27, MY 28, MY 29, MY 30, MY 31, MY 32, MY 33 and MY 34 : B 13, B 17, B 18, B 19, B. 31, B 33, B 35 and B 36 : MP 6, MP 16, MP 17, MP 18, MP 25, MP 29, MP 30 and MP 34: MR 7 and MR 8).

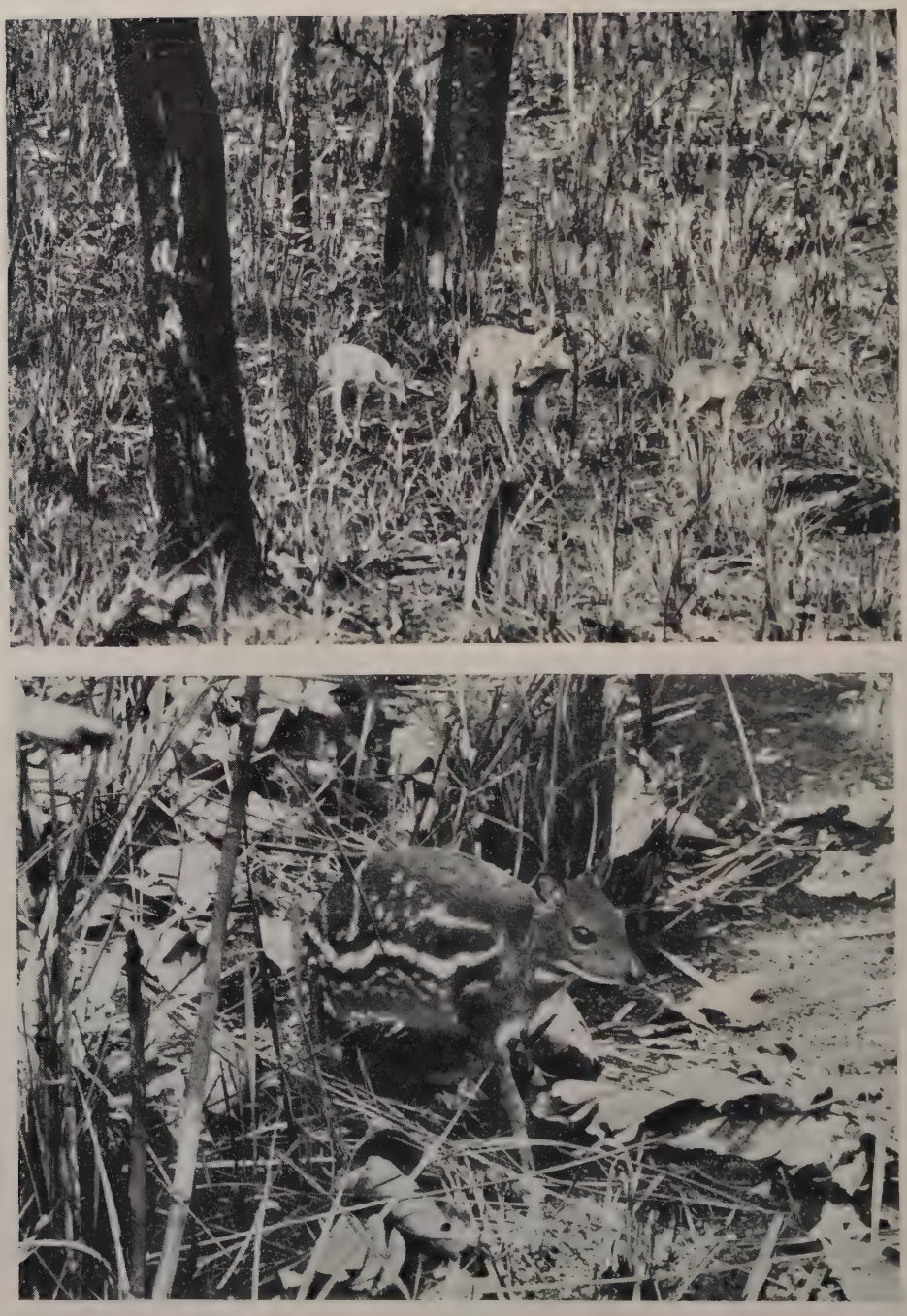
It was not by chance that the animal seen oftenest during the survey period was the chital of which more than 300 distinct observation records are noted in the field notes, documented by no less than 44 photographs. Since, naturally, all animals seen in a herd were listed as one sighting, the total number of chital seen must be several thousands, although none was seen in Kerala, and only a few in Andhra Pradesh and Orissa. The chital is undoubtedly the commonest wild animal of peninsular India, and I think it is the most adaptable and the fastest breeding of all Indian deer. Chital have been hunted as widely and assiduously as any other wild animal, by every class of hunter, but still thrive where all others have dwindled.

Quick breeding is not the only, or even the main, reason for the chital's survival where so many other species have declined so quickly. Adaptability, the ability to colonise new areas as it is deprived of established territory, and the ability to exist in a reduced physical condition are all of obvious survival value to any animal faced with many kinds of adverse influences, and the chital has all these qualities. Perhaps it is the best example of vitality being very much a matter of bionomic flexibility, but before detailing this important aspect of its life, a limitation imposed on breeding in some fast-breeding herbivores should be pointed out.

Among chital (as in most herbivores) copulation is over in a few seconds, and there is marked sexual promiscuity, but for these reasons it cannot be presumed that swift matings lead to fast breeding. In some animals (notably the primates) the sexual urge, seasonally or periodically compulsive, finds comparatively uncomplicated and casual expression in easy access, promiscuity, or coercive male dominance. Among chital (as in most deer) the ritual of courtship, which may be longdrawn, precedes copulation (TN 64 Oct. 2, 6 : photograph TN 42). It is not as if a chital stag walks into a herd where there is a receptive hind, mates with her, and passes on—the courtship, in full or at least in abbreviated

Above : BIHAR 1969 : HAZARIBAGH N.P. : February 15 — 8.30 p.m. : Female muntjac and young — B. 10 ; *Below :* MAHARASHTRA 1969 : TAROBA N.P. : November 17 — 11 p.m. : Muntjac crossing the road — MR. 9.

(*Photos : M. Krishnan*)



Above : TAMIL NADU 1964 : MUDUMALAI SA. : Kargudi : April 1 — a.m. : Female muntjac with 2 young — TN. 37 ; *Below :* TAMIL NADU 1964 : MUDUMALAI SA. : Kargudi : April 2 — p.m. : Female mouse deer — TN. 34.

(*Photos : M. Krishnan*)

form, has to be gone through. For this reason, matings may on occasion be frustrated by other factors, such as disturbance, but after all it is the oestral cycle of the female and the period of gestation that mainly determine the rate of breeding and not the overt male-female pattern of sexual behaviour, and even if it is presumed that extraneous factors may frustrate mating in as high a proportion as 10% of the total possible matings, it makes little difference to the rate of breeding, for 90% of all fertile females that come into season will be impregnated, conceive and give birth to young after the period of gestation of the species. It should be noted that population levels are not dependent only on birth rate : infant and juvenile mortality are important factors in limiting populations, but of course a high birth rate will compensate in a measure for such mortality.

The fact that chital are highly gregarious has itself considerable survival value. It is usually found in herds and though the composition of the herd may be unstable and readily alterable, the fact remains that the animal goes about in herds. Animals in close herds are better warned and better protected against predators and accidental damage, and though such gregariousness does have its own attendant risks (as when an individual contracts an infectious disease), it also serves to stimulate free ranging and thereby leads to more efficient feeding.

Much more than this, the chital's ability to feed on what offers, and its adaptability with regard to cover, terrain, and even sources of water (which it must have) have great survival value. It is always the animals with rigid or specialist feeding habits that are most affected by hostile influences. The chital is truly versatile. Introduced into the Andamans where the floristic and territorial settings are so different from what it is used to, the chital has overrun the islands and flourishes, to the acute embarrassment of the Forest Department. In the Sunderbans the chital swims across channels, feeds on plants very different from those of its usual haunts, and even eats crabs.

The chital appears to be originally and mainly an animal of the more open, well-watered forests, where deciduous tree cover alternates with maidans and belts of open scrub : though very different in their floristic and other characteristics, the Corbett and Kanha N.Ps. and the Mudumalai and Bandipur Sas. have these main features, and it is here that chital attain their best development. However, introduced or straying into dense forests, they change their habits readily, go about in small parties rather than in herds, and usually decrease in size—no information is available on the size of chital in the Andamans, but if other factors do not influence it, on the basis of what has been said it should be a smaller size than that attained by chital in the parks and sanctuaries mentioned. Introduced into dry, thorny littoral scrub, as in Guindy Park and Point Calimere, chital degenerate in size and

forage in parties rather than in herds, but are nevertheless able to hold their own against the native fauna and even to oust it.

Chital are not free-ranging animals, but when moved out of their usual haunts by some evictive force, they take readily to the altered circumstances of the new setting (TN 64 Apr. 6 and 8) : few animals of a more or less resident normal habitat have a less compulsive sense of territory than chital.

Size : Morphological characters

Size varies considerably, as has been said already. The question of size is not dependent so much on the latitude of the chital's range, as has been assumed, as on the nature of the terrain and flora. As fine animals as are to be seen in the Corbett (trans-peninsular) or Kanha N. Ps. are to be seen in the Masinagudi area of the Mudumalai Sa. : it is significant that in the denser adjoining tree forests of the same sanctuary at Kargudi and Theppakkadu, chital display a marked dimunition both in size and in the numbers in which they habitually associate, and that even in the Bandipur Sa., contiguous with Theppakkadu, they do not attain the size they do in the Moyar-Masinagudi area. However, it is generally true that size declines from the north to the south of the peninsula.

Colour and patterning of the coat also show considerable variations, probably more dependent on genetical strains than on environment. In the Shivpuri N.P. it was noticed that several stags and hinds carried much larger white spots than is usual (MP 69 Apr. 1 and 2 : photograph MP 25).

In some animals the white spots are noticeably small, and in them the burnt sienna of the surrounding coat has a purplish cast or sheen to it, a cast which does not appear to be directly related to the animal being in breeding condition, though in stags in hard horn the sheen was most apparent (MY 68 Oct. 22, 69 Oct. 12—vide note under this date for a brief account of colour variations noticed). In the fawns the white spots are small and inconspicuous, being partly obscured by the pile of the pelage around them (photograph MY 34).

The black or very dark dorsal median stripe (along the back) was not observed on adult stags in the early stages of velvet, though some of them were of large size, but was seen on stags in hard horn and on adult hinds (not all), even on an adult hind that was heavily gravid : another hind (old) was seen that had no vestige of the dorsal stripe (TN 64 Oct. 2 ; MP 69 Mar. 7 and 10 ; MY 68 Oct. 8 and 21, MY 69 Oct. 12 and 22).

Size and formation of the antlers differ with locality, and are probably dependent mainly on heredity and strain. For example, stags with the widely divergent type of antlers seen in the Kanha N.P. (MP 68 May 3

Above : MAHARASHTRA 1968 : TAROBA N.P. : November 23 — about 6.30 p.m. : Pig crossing the road. Note ridge of hair along back and thick limbs — MR. 5 ; *Below :* MAHARASHTRA 1969 : TAROBA N.P. : November 20 — about 8.30 p.m. : Pig at the roadside, near lake — MR. 11.

(*Photos : M. Krishnan*)

Above : MAHARASHTRA 1969 : TAROBA N.P. : November 22 — about 7.30 p.m. : Pig at the lakeside — MR. 12 ; *Below :* MAHARASHTRA 1969 : TAROBA N.P. : November 23 — about 8 p.m. : Close-up of a big sow — MR. 14.

(*Photos : M. Krishnan*)

and 6, 69 Mar. 11 and 18 : photograph MP 6) were not seen elsewhere in the peninsula, except for a few big stags in the Moyar-Masinagudi area of the Mudumalai Sa., which, however, did not have the antlers so widely divergent as some of the Kanha stags, though in point of size their antlers seemed as big or superior (TN 62 Mar. 27, 64 Oct. 4, 69 Oct. 2 : photograph TN 41). Some stags in the Corbett N.P. had antlers as widely divergent as those seen at Kanha.

The best antlers were carried by stags seen in Kanha and in the Masinagudi area of the Mudumalai Sa. ; some stags in the Bandipur Sa., too, had very fine antlers but they were not as big built as the Masinagudi stags. One very stoutly built stag in the Kanha N.P. carried the heaviest antlers I have seen on a chital (MP 69 Mar. 13 : photograph MP 18), and some other stags at Kanha, still in velvet, also had exceptional antlers (MP 70 Mar. 11 : photograph MP 29). Photographs MY 18, MY 27 and MY 29 show a medium-sized stag with fine antlers not yet clear of velvet, and two close-ups of the same reclining stag in hard horn, taken at the Bandipur Sa. I was unable to get a clear picture of a big stag at Masinagudi, though I tried to get one for years. Some stags from that area not only carry very fine antlers but are also magnificently built. The brow tine in stags seen in the south of the peninsula, generally speaking, was poorly developed compared to chital in the Kanha and Corbett parks.

Distribution

I am unable, in spite of diligent inquiry, to collect precise and reliable data on the occupation of the known homes of chital by humanity, and the movements of chital into areas where formerly they were uncommon. While no dependable information is available regarding the probable introduction of chital into the Pt. Calimere Sa., I can say from personal knowledge that when the Raj Bhavan at Guindy was developed, chital from Government House at Mount Road were shifted to the deer park at Guindy, which enjoys the appellation ' deer park ' even today, though the natural faunal feature of the small area is its blackbuck. Another comparatively recent introduction of chital into a littoral area was made by the Raja of Kanika some years ago, and the chital introduced by him into Vhitar Kanika are still there and thriving, in a somewhat exotic setting (O 70 Jan. 27).

Habits : Behaviour

The composition of the herd is unstable : large herds split into a number of parties which may reunite in part or whole, or reorganise themselves into new herds (TN 62 Apr. 6). Even chital in comparatively small parties of a dozen or so are liable to change of structure from time to time (TN 64 Sep. 18, Oct. 2, 6 and 7). The large herds are always

to be found only where the ground is comparatively open, with maidans and open scrub, and are usually made up of many parties, together for a variable period. Any disruptive influence, such as an acute threat by men or wild dogs, usually scatters such herds into several parties. Chital moving into fresh ground are exceedingly fugitive and wary, and are highly gregarious but on familiar ground may break up into parties and flee, only to reunite (TN 64 Apr. 6). It should, however, be pointed out that the breaking up of a herd into smaller units does not, in itself, establish any inherent instability in the herd. For two reasons, this is so, though these are, to borrow a convenient phrase from the law, mutually exclusive. If a local population is to be taken as a whole, as it can be in chital, which are not far-ranging, it makes little difference whether the component parts of the population are associated in a rigidly fixed manner or in a more changeable and transient association. Again, if a herd is to be considered as a gregarious social unit, it moves and functions as such a unit while it does so, even if it is liable to disruption and reformation. This point is laboured because chital are highly gregarious, and since much of their activity and even repose is based on this gregariousness, it is necessary to realise that their groups associations are not purely accidental.

In fact, the very large numbers of chital seen together in a herd, in areas where the ground is comparatively open, will attest to this basic gregariousness of the deer. A herd I counted at Masinagudi, when it was (for once) possible to count the chital fairly accurately, as they moved more or less in a straggling line up a rise along a track, numbered over 220 : H. Rajagopala Shetty who counted the same herd from a point of vantage where he could see them against the sky as they moved up the rise, had a count of 240+. We were separated by about 2 furlongs and his count, made in more favourable circumstances, was very likely the more correct (TN 62 Sep. 26). A smaller herd seen in the same area, of about 150 chital, could not be photographed together, but a section of it is shown in photograph TN 21 (TN 62 Sep. 23). On several occasions herds of over 100 or 150 chital were seen in the Masinagudi area : even in Bandipur, some large herds were seen, although the less open forests here do not encourage large herds to the same extent (MY 68 Oct. 7, 25, 69 Oct. 12, 22 : photographs MY 15, MY 20, MY 28 and MY 34). In Kanha, too, some fairly large herds were seen. In the Corbett N.P., where the chital emerge from and retreat into the sal cover in small parties in the evenings and mornings (respectively) they are not found in large herds within the sal cover, but once they are out in the open, they associate in large numbers.

In no deer do the groups of adult males, variously termed schools of stags and stag-parties, attain the numerical size that they do in chital. Naturally, since chital are found in large herds only in comparatively

Above : MYSORE 1968 : BANDIPUR SA. : October 10 — a.m. : Pig drinking at Kollakumalikatté — MY. 6 ; *Below :* TAMIL NADU 1966 : MUDUMALAI SA. : Kargudi : September 23 — p.m. : Pig's nest — TN. 46.

(*Photos : M. Krishnan*)

Above : KERALA 1970 : PERIYAR SA. : April 22 — p.m. : Lone boar wallowing at the water's edge — K. 12 ; *Below :* KERALA 1970 : PERIYAR SA. : April 27 — a.m. : Boar, with attendant myna — K. 15.

(*Photos : M. Krishnan*)

open country, in the tree forests where they do not occur except in parties of from 3 or 4 to two dozen, large stag-parties cannot be expected. In barasingha (*Cervus duvauceli duvauceli* and *C.d. branderi*), stag-parties are known and have been described, but though these appear to have been comparatively large in the past, today the dominantly male associations seldom seem to attain a strength of even 50. In chital, a herd of stags may number over 100 and be entirely male, or contain a few old hinds or even a few subadult females which do not alter the overwhelmingly male character of the association. Such large stag-parties were repeatedly observed in the Masinagudi area of the Mudumalai Sa., and nowhere else (TN 62 Sep. 25, 64 Oct. 4 : photograph TN 41, 66 Sep. 16 and 17, 66 Oct. 2). In other places stag-parties seen were comparatively small, containing only some 4 to 10 animals (MR 69 Nov. 16 : photograph MR 8 ; MP 70 Mar. 5 : photograph MP 30). J. Mishra commenting on such parties of stags in the Palamau N.P., informs me that in all parties seen, the stags were in velvet. This must have been a coincidence. In herds of stags, as also in large mixed herds, all stages of antler development were observed, some stags having polled heads (having just shed their antlers), some being in the early stages of regeneration with the swollen tine-tips covered with velvet, some in the penultimate stage with the antlers fully developed but still covered with velvet, and some in hard horn : even in small stag-parties, usually some animals were in velvet and some in hard horn (TN 62 Sep. 13, 63 Sep. 25 ; MR 69 Nov. 16—photograph MR 8).

This lack of a season for antler-shedding is perfectly in accord with the fact that breeding is not confined to any season but takes place throughout the year. This may be further proved (apart from the stags being in velvet and in hard horn throughout the year) by the fact that young fawns may be seen at any time of the year. Some observers have, while conceding the fact that breeding takes place practically throughout the year, postulated a peak breeding season. Schaller, after agreeing with me that at Kanha the rut continues throughout the year, adds that sexual activity increases greatly from March to June with a peak in May. The evidence he cites includes the braying of the stags as denoting their sexual excitement. Undoubtedly braying does have a basic sexual significance, but it also seems to have a purely social function : it is invariably indulged in by a stag which, whether it is in the company of other stags or not, seems to be feeling alone, and on joining the herd or a party, or even some other stags, the braying is given up (MP 69 Mar. 9; B 70 Mar. 2). Further, the number of brays heard on successive days from a standpoint in the Kanha meadow seem to be no dependable indication of the number of stags actually braying, for fortuitous circumstances condition the record (MP 69 Mar. 8 ; vide notes). An aspect of braying by the stags as being an indication of sexual excitement

that does not seem to have been considered by observers so far is that it seems to be commoner in some areas than in others : for example, it is much less common in the Masinagudi areas and in Bandipur (where the chital populations are considerable) than in the Kanha or Palamau N.Ps. Why this should be so I do not know. It will be necessary to investigate brayings all round the year in all such areas before any reliable data can be considered.

A necessary consequence of breeding being spread out over the entire year is that at no time are a large number of very young fawns seen with the adults. If breeding was defined and seasonal, such a noticeable proportion of very young fawns would be inevitable, for in order for the species to survive it must reproduce adequately, but naturally, with reproduction diffused over the year, the number of infants is at no time sharply apparent or conspicuous. I consider this adequate proof of there being no breeding season.

Schaller provides a description of the various attitudinal displays that serve in intraspecific communications in chital : these are specially noticeable in captive chital in a paddock, and not merely because they are most readily observed : it may be said that their main function, when they are threat displays, is to avoid actual conflict when a gesture of domination is responded to with a submissive gesture.

Both the head-up and head-down displays are indulged in, the former more commonly by hinds (which may, in continuation of a mutual head-up, rise on their hind legs and strike out at each other with their forelegs—MY 68 Oct. 7) and the latter by the stags ; however, both displays are much less frequent among wild chital than among chital in captivity : this is difficult to understand because, in wild chital, where the dominance values have already been established in a herd, these displays are uncommon, and in a paddock dominance values are well established for the time being. In a herd, stags in hard horn naturally take precedence over stags in velvet, even a brocket over a big stag in the early stages of velvet. When 2 stags of a size, both in hard horn, are moving more or less side by side, they sometimes walk stiffly, with the head slightly averted at the stretch of the neck, and roll their eyes (displaying the white of the eye) from time to time—apparently such stags are maintaining an armed neutrality towards each other (MY 69 Oct. 14 : photograph MY 25 shows a brocket adopting this gait and attitude while walking besides another brocket which is biting at its hind quarters). One light-coloured stag with distinctively short and upcurled brow lines, running with a hind, threatened other stags that came too near with a curious demonstration which exactly duplicated the demonstration aimed at us and the riding elephant by the big bull of a herd of wild buffaloes in Kaziranga : this stag lowered his antlers and leaped forward towards the intruder, not following up the leap with a lunge, but braking it with

stiffly braced forefeet and coming to a rocking halt (MY 69 Oct. 22.) Another stag, bigger and darker, also running with a hind, intimidated stags that came near with a head-down display, and sent the light-coloured stag running with a mere, pointed look without any display (MY 69 Oct. 22 : photograph MY 31). Young stags (naturally, only those in hard horn) indulged in brief bouts of sparring (MY 69 Oct. 14 : photograph MY 26) and older stags in hard horn with well-developed antlers occasionally thrashed the bushes (MY 68 Oct. 23 : photograph MY 13) which, apparently, is a form of redirected aggression, or a demonstration.

The most commonly used display to move other chital was not attitudinal but purely ocular. Chital are not unique in using a sharp, pointed direct look, or a sideways glare, as a means of intraspecific communication : barasingha and sambar also use them, and the direct glare of some of the greater cats at a human intruder, with the head raised high, is also basically similar, though not intraspecific in its communication. However, the use of the rolled eye (to display the white) without any attitudinisation, and of a pointed glare to direct a subordinate are specially noticeable in wild chital (MY 68 Oct. 8, 69 Oct. 14 and 22).

The bite-threat was commonly used by hinds towards one another, and once by a brocket towards another (MY 69 Oct. 14).

A threat or demonstration common to most horned animals, and freely indulged in by stags (directed at other stags, usually) is the lowering of the antler or horn and a lunge forward. This was noticed several times. In gaur the threat sometimes results in a sharp prod, but in chital the gesture was more formal, and I did not see any stag indulging in this demonstration prod the threatened stag.

The purpose of these attitudinal and ocular displays, and these demonstrations, is presumably to avoid actual physical conflict in a gregarious association, and also to serve as an expression of dominance : displays of the acceptance of such assertions of dominance and expressions of subordination are also well-known, the commonest of them being retreat by the subordinate animal : a more formal submissive display is a sudden preoccupation with grazing. In chital, sometimes the aggression of a stag in a herd towards another is not merely a threat or a demonstration, but a sharp attack which, if not avoided swiftly, may result in a bad goring.

It is necessary to make this point more fully, because in few animals are serious injuries caused by such sudden attacks so common as in chital, and the point does not appear to have been commented on before. Wherever chital are a prominent feature of a faunal area, a number of limping stags may be seen, usually by themselves or with another stag or two, but sometimes in a herd (MP 68 May 1 and 5; MY 68 Oct. 5;

MP 69 Mar. 8, MY 69 Oct. 23). In some of these limping stags, gored wounds were seen. Where it is very badly wounded (and even a casual lunge with a chital's antler can cause deep, punctured wounds), the stag gored usually is by himself, and often found lying down in cover (MP 69 Mar. 8 and 13—very probably the same stag). Such an injury might result in permanent lameness (B 69 Feb. 24 and 26, and B 70 Feb. 28 : photographs B 19 and B 36 : the photographs show the same lame stag after the lapse of a year : he was still lame, and his antler, *opposite* the side on which he was injured, was still malformed). In the last instance, of course, it was not established that the injury was the result of a goring by another stag, but it was very probably that, for reasons stated in the next paragraph.

Sudden attacks by one stag in a herd or party on another, resulting in a deep, gored wound, were actually witnessed (MY 68 Oct. 22, MY 68 Oct. 27 and MP 69 Mar. 13). Only in one of these instances was the attacking stag running with a hind (photograph MY 14) : stags running with hinds are very intolerant of the presence of other stags, even of brockets (TN 64 Oct. 2 and 6). Stags with hinds do attack other stags, and may be attacked by another stag attracted to the hind in season, and fights between stags may result even in the death of one of them. J. Mishra has provided me with a circumstantial account of such a death, wherein it was proved, as conclusively as possible in a post mortem investigation, that the cause of death was gored wounds inflicted by another chital stag—this was in the Palamau N.P.

Though many of its intraspecific communications are visually apprehended, the chital's eyesight is only fair, and it is not quick at making out immobile objects (TN 64 Apr. 12) : its night vision appears to be less acute than that of blackbuck (MISC 60 June 8). However, it does normally seek visual confirmation of danger apprehended through the other senses.

Hearing is probably more acute than is generally appreciated. Chital do listen for many sounds, their own intraspecific calls, and the alarm calls of other animals. In the Bandipur Sa., where the alarm calls of peafowl may be commonly heard, every chital in a large herd was alerted and turned towards an alarm sounded by a peacock (which, to my ears, seemed no more urgent than the other alarm calls sounded by the bird from time to time : MY 69 Oct. 23 : photograph MY 32). In an experiment tried, one chital was confused by an echo (TN 63 Apr. 2 : photograph TN 25). Alarms are communicated by chital themselves both visually and vocally—the raising of the tail in flight and the consequent exposure of the white ventral surface of the long tail is a flagrant visually communicated alarm : the shrill barkings of the deer, usually at the sight or suspicion of a leopard or tiger (TN 63 Apr. 4, Sep. 18 ; MP 68 May 13 ; MR 69 Nov. 18—it is seldom sounded when wild dogs are on the

trail of chital—MP 69 Mar. 14) is an alarm well understood not only by other chital but also by other forest animals. The quick, repetitive stamping of the forefeet, though not a vocalisation, is also an alarm communicated by being heard (B 69 Feb. 25 : photograph B 18).

Perhaps the most remarkable intraspecific vocalisation of chital is the 'conversation' that hinds indulge in when in cover. This does not appear to have been described, and so may be detailed here. Hinds speak to one another, usually in cover, in a low, bird-like, mewling voice ; these calls of chital hinds are richer in variety and better modulated than the mewling 'Chchaai' of barasingha already described, as was specially noticeable when these calls of both the deer were heard together once, at the Kanha N.P. (MP 70 Mar. 21). Chital hinds were heard and observed indulging in these calls on several occasions and in different locations (TN 62 Mar. 19, TN 64 Apr. 4; MP 68 May 7; MY 68 Oct. 6, MY 68 Oct. 24 ; MP 70 Mar. 21).

A remarkable variant of this mewling call is when it is used (to borrow a convenient phrase from telephonic communication) as a 'particular person call' and a warning call. This call is quite loud and longer than the conversational mewling, but is basically the same. Chital hinds were twice heard warning stags of our near approach on elephant back, though on both occasions the stags were aware of our proximity and unafraid (MP 70 Mar. 20 and 21).

Chital seem less dependent on smell than other deer, though the sense of smell is highly developed. They do not seem to be able to appreciate airborne scents when the wind, blowing towards them, is strong (TN 64 Sep. 30). Some hinds actually ate the follicles of a creeper (*Pergularia extensa*) draped over me, without being aware of me, but in the circumstances (the freshly broken creeper having a smell) perhaps this is not conclusive evidence of their poor scenting abilities (MISC 60 June 7). They are certainly able to scent a man when they cannot see him (TN 66 Sep. 17).

Being versatile feeders, what they eat is probably much more dependent on what is available than on decided dietetic preferences. They eat short grass (which seems to be the main fodder in open scrub and forest) steadily, grazing as they go along (MY 69 Oct. 14 : photographs MY 24, MY 34), when in a herd grazing in close formation ; while coarse tall grasses are not relished, thin grasses of medium height are also eaten (MY 69 Oct. 9 : photograph MY 21). Grazing is not always in bulk and sometimes much time is spent in feeding choosily on minute ground vegetation (TN 62 Mar. 25). A number of herbs and shrubs are also eaten among them *Grewia aspera* and *G. hirsuta*, *Helicteres isora*, *Toddalia aculeata*, *Limonia alata*, *Pavetta indica*, *Indigofera* spp. and lantana (MY 69 Oct. 7 and 22). Tree foliage is also browsed (such as that of *Emblica* spp., often eaten while standing erect on the hind legs : MY

68 Oct. 8 : photograph MY 2), in bulk when short grass is not freely available. The fruits of *Toddalia aculeata* (TN 62 Sep. 25), *Aegle marmelos* (B 70 Feb. 26 : photograph B 35) and *Zizyphus xylopyrus* (the foliage is also relished), *Ficus glomerata* (MP 69 Mar. 10), *Randia dumetorum* and other forest fruits are freely eaten. The association between chital on the ground and langur up trees has often been noticed and commented on, but seems to be one where there is no mutual benefit, but purely a scrounging association (TN 62 Mar. 25 and MP 69 Mar. 10). The bulk of the feeding is done in the morning, from about 7 a.m. to 11 a.m., and in the afternoons : some feeding is also done at night. The main periods of rest depend, to some extent, on how much fodder has been available, for when well fed chital lie down to chew the cud : however, they are usually lying down early at night, late at night, early in the day before and after dawn (MY 69 Oct. 22 : photographs MY 28 and 29) at midday. At night the parties often assemble into herds.

Water is a prime necessity. Chital drink at night, and at many times during the day, but mainly in the morning, at noon and in the evening (MY 68 Oct. 8 and 11 : photographs MY 1 and MY 8 : B 69 Feb. 17, 21, 23 and 25 ; B 70 Feb. 22, 23, 24, 25 and 28 : photographs B 13 and B 33). They are usually very cautious in their approach to the water, and scout the ground ahead and on all sides before lowering their muzzles to the water : as a rule they slake their thirst quickly, drinking deeply and continuously, but a stag in velvet, was observed to drink for 6 minutes. As this is a report concerned mainly with ecology and not with behaviour, behaviouristic observations noted on the occasions listed above have not been abstracted in the field notes, but it was noticed that when approaching water apprehensively, particularly when no other animal was already drinking at it, young or subordinate animals were frequently forced into the lead with pointed looks and threat displays. Chital drink, even at small pools, freely along with other animals, such as gaur or peafowl (photograph B 17).

Cattle are frequently grazed in areas noted for their chital, as at Masinagudi and Bandipur, and cattle-borne diseases, such as rinderpest, may be communicated to the deer (MY 68 Oct. 15 and 24). It was noticed that a stag affected with rinderpest sought seclusion and cover, when very ill (MY 68 Oct. 10). Deaths from predation were also noticed (TN 66 Oct. 4 ; MP 70 Mar. 14).

THE MUNTJAC

Muntiacus muntjak (Zimmermann)

(Summary of field notes : Observation records: 37.

Locations: Kerala—Periyar Sa.; Tamil Nadu—Mudumalai Sa.; Mysore—Bandipur Sa.; Orissa—Raigoda Sa.; Usha Kothi Sa.; Bihar: Hazaribagh N.P., Palamau N.P., Kodarma; Madhya Pradesh—Churna, Bastar, Bara Naya Para; Maharashtra—Taroba N.P.

Photographs: TN 37: B 10: MR 9).

The muntjac was seen occasionally in most forests visited, and heard quite a few times. An excellent account of it is provided by Dunbar Brander.

Size : Morphological characters

Adult size differs with sex, and also with location. The male is about the size of the chowsingha, the female smaller. Colour also differs in the sexes, the male generally being a bright chestnut or a burnt sienna and the female paler and more fulvous. The canines in the upper jaw of the male are, as Dunbar Brander points out, formidable weapons, inflicting deep, gashed, wounds : these are not fixed rigidly in the jaw but are capable of some movement. I still carry a 3-inch scar on my leg from a deep gash inflicted by a zoo muntjac over 40 years ago, acquired when I was curious with regard to dentition and tried to have a closer look. Prater says that the young are spotted till about 6 months old. Two infant, hare-sized young seen with their mother and watched closely for a long time were whole-coloured, and showed no spots (TN 64 Apr. 11 : photograph TN 37).

Distribution

Within the peninsula the muntjac is confined to the hill forests, though their elevation, as at Periyar and Bandipur, may not be apparent at first sight.

Habits : Behaviour

The muntjac is usually solitary, though at times it may be seen in a pair, or an adult female with one or two young. (photograph B 10). As Dunbar Brander points out, it keeps more or less to the same forest area, its range.

Dunbar Brander comments on its stilted gait, the feet being raised and set down almost vertically, with a high-stepping, delicate action, as if treading on eggs. This action is not the normal gait of the animal, but adopted when it is conscious of being watched and at the same time not seeking instant escape by flight. An adult female which crossed the forest road ahead of our jeep moved with this exaggerated action,

and I was impressed by the way the gait lent itself to a bounding getaway at once in any direction desired (MR 69 Nov. 17 : photograph MR 9). The normal response to men (even when in a jeep or on elephant back) is instant and precipitate flight (TN 64 Apr. 11 ; B 69 Feb. 15 ; K 70 Apr. 29, a.m. and p.m.). Even heavily gravid females tore away at top speed on sighting men on elephant back, jumping over bushes 3-foot high (TN 62 Mar. 23, 63 Apr. 1). The normal gait of a muntjac moving along the forest floor is an easy, slow walk.

Muntjac are choosy feeders. An adult female (the one with the 2 infants at heel) was watched for quite some time, and ate grass shoots and herbs selectively ; she lifted her head to an overhanging leafy twig (of *Zizyphus xylopyrus*), wrapped an astonishingly long tongue around the twig, and stripped the foliage off it by withdrawing the tongue into the mouth (TN 64 Apr. 11). Barking deer are very fond of the fruit of *Melia composita*, intensely bitter to the human taste (O 69 Jan. 16 and 18).

As Dunbar Brander points out, the sound as of castanets sometimes accompanying a muntjac's precipitate departure is purely vocal, merely the normal alarm call (always sounded standing) diminished in volume and broken up into staccato sounds by the rapidity of the movement ; I, too, have observed this from close quarters. Some muntjacs have hoarse, and some sharper voices.

THE INDIAN CHEVROTAIN

Tragulus meminna (Erxleben)

(Summary of field notes : Observation records: 9.
Locations : Tamil Nadu—Mudumalai Sa.; Orissa—Nawana (Simlipal hills).
Photograph : TN 34).

Unless one goes looking for it specially, on elephant back, the mouse deer is easily missed. One seen in the Kanha N.P. is not recorded in the field notes because all that was seen was an agitation of the undergrowth going away from the riding elephant with an occasional glimpse of a whitestreaked olive brown coat.

Size : Morphological characters

Prater gives the height at the shoulder at 10 to 13 inches, but gives no weight. An adult female weighed 12 lb.

Distribution

Prater gives the 24° latitude as the northern limit of the mouse deer in the peninsula. I have seen it almost commonly in Karwar and in some forests in south India.

Habits : Behaviour

Besides feeding on herbs and shrubs on the forest floor, mouse deer eat a number of fallen fruit, among them the fruits of *Terminalia bellerica, Gmelina arborea* (much liked by all deer) and *Garuga pinnata.*

When standing at ease, a forefoot or a hind foot is often trailed, as if lame in that leg (TN 64 Apr. 2). The gait is a trot when moving fast, or when walking a creep. A thickset male watched for some time panted open-mouthed like a dog, though without the tongue hanging out of the mouth (TN 64 Apr. 10). Mouse deer can climb up sloping tree boles and often go to earth in a hollow tree. They lie up in grass or even on the bare earth, like a hare in its form.

THE WILD PIG

Sus scrofa cristatus Wagner

(Summary of field notes : Observation records: 85.

Locations: Kerala—Periyar Sa. ; Tamil Nadu—Mudumalai Sa., Pt. Calimere Sa.: Mysore—Bandipur Sa.: Andhra Pradesh—Kawal Sa.; Orissa—Raigoda Sa., Usha Kothi Sa.; Bihar—Hazaribagh N.P.; Palamau N.P.: Madhya Pradesh—Kanha N. P., Shivpuri N.P., Churna ; Maharashtra—Taroba N.P.

Photographs : TN 46 : MY 6: MR 5, MR 11, MR 12 and MR 14; K 12, K 15, K 16 and K 20).

Except in the Periyar Sa. and Taroba N.P., pigs were not often seen, though their slots, and the ground they had dug up, bore testimony to their being there. Large sounders were seen in Kanha, Bandipur, Taroba and Periyar : only small parties in other places, though there seemed to be plenty in Shivpuri.

Size : Morphological characters

Apart from the boar being considerably larger than the sow (though some old sows are of impressive size), adult wild pig vary in size from place to place and even within the same area. Prater gives the height of a well-grown boar at 3 feet and its weight around 500 lb. Some big boars were seen, but not of that weight.

Distribution

All over the peninsula, in open forests. In forest-side areas, pigs are determined crop-raiders, and do substantial damage to groundnut, digging up an entire field overnight.

I thought the pig at Point Calimere Sa. probably feral and not truly wild. Since indigenous domesticated pig are probably descended directly from the wild animal, it would be difficult to distinguish between feral and wild pig—as in the buffalo, feral animals look very like their wild ancestors.

Dr. H. Khajuria of the Zoological Survey of India, consulted, informed me that on the basis of skins examined by him he could find no crite-

rion for distinguishing between wild and domesticated pig by a morphological characteristic. The question is obviously one that will have to be decided by a taxonomist, but I still feel that the pig at Point Calimere are feral and not truly wild. There are no wild pig anywhere around this isolated coastal forest but there are domesticated pig in villages not too far away. Cattle and ponies have been allowed to run wild, and have run wild, here, and it could well be that a few village pig which had escaped to the Kodikadu Reserved Forest were the basis for the present population of 'wild pig': there are no predators here large enough to act as a check on the pig. The one possibly significant point I noticed about the pig at Point Calimere was that even on the largest boars the ridge of hair along the back from the nape, thick in wild pig and with only a slight backward slant when not erected, was noticeably thin and had a lean to one side (TN 68 Dec. 10, 69 Dec. 12 and 18). The subspecific distinction of *Sus scrofa scrofa* of Europe from *Sus scrofa cristatus* of India appears to be sustained in part by the thicker and more luxuriant dorsal ridge of bristles of the latter (photograph MR 5).

Habits: Behaviour

Wild pig seen by day were extremely fugitive, and bolted at the sight or scent of man (TN 59 Mar. 7 and 22, 63 Mar. 25 etc.). A lone boar met on foot by day was singularly reluctant to move away, even belligerent (TN 64 Sep. 17). Pig running away do not turn round for visual confirmation of a scent warning or to see if they are being followed: they change direction suddenly in flight, and take advantage of every dip and bit of cover to disappear from view.

In the thicker tree forests, no sounders were seen, but only pig in small parties and singly: large sounders were noticed where the ground was more open and there were clearings and maidans, at the Periyar Sa., the Bandipur Sa., the Kanha and Shivpuri N.Ps. and the Taroba N.P. (K 60 Apr. 18, K 70 Apr. 28: photograph K 16, K 70 Apr. 29: photograph K 20; MY 68 Oct. 10; MR 68 Nov. 15 and 16, MR 69 Nov. 20: photograph MR 11, MR 69 Nov. 22: photograph MR 12: MP 70 Mar. 17 and 18).

In the Taroba N.P. cattle egrets followed the pig coming to the lakeside in the evening (MR 68 Nov. 17, 23 and 25). In the Periyar Sa. common mynas were seen accompanying the pig and riding on their backs (K 70 Apr. 27: photograph K 15).

Pigs are very fond of wallowing, but differ from other animals that like to wallow (buffalo, elephant, sambar) in that they like some shallow water over the mire, and not merely mire, for this purpose. Once I saw a very big boar lying in 3-inch deep water in a puddle on a forest road, soon after heavy rain, rolling over and squirming about so violently that at first I thought the animal had been seized with a fit. Pigs were

Above : KERALA 1970 : PERIYAR SA. : April 28 — a.m. : Part of a sounder of over 30 pigs — K. 16 ; *Below :* KERALA 1970 : PERIYAR SA. : April 29 — p.m. : A line of pigs on the move — K. 20.

(*Photos : M. Krishnan*)

observed wallowing in shallow, miry water on a few occasions (TN 66 Apr. 25; MY 68 Oct. 10; K 70 Apr. 22: photograph K 12). They rub their sides and hindquarters well into the mire to get them scrubbed, with squirming and rolling movements.

They were seen drinking at midday, in the afternoon, and late in the evening (MY 68 Oct. 10: photograph MY 6; MP 69 Mar. 23; B 70 Feb. 8, 9 and 12).

At Point Calimere I was assured that the local pig hunted crabs at night along the wave-line, and ate stranded fish. In the Taroba N.P. I saw them hunting some active, live prey, but could not identify it—perhaps they were hunting frogs or insects in that soggy grass. No doubt they do eat a variety of animal prey, and carrion, but the bulk of their food is vegetarian and much of it the underground stolons, rhizomes, corms and bulbs of plants.

It is astonishing the way pig can dig up the ground with their nose. A groundnut field visited overnight by pig, looks as if it had been freshly ploughed up, but it is not only soft, agricultural soil that their snouts can dig up. In Point Calimere and in the Masinagudi area of the Mudumalai Sa., I saw hard-packed ground covered with grasses and herbs, criss crossed with deep-ploughed lines where the pig had been feeding on the underground parts of *Cyperus* spp. and other plants (TN 68 Dec. 10). They eat tender tall grass and root for the stolons and rhizomes of sedges and grasses (K 70 Apr. 23, 28 and 29; MR 68 Nov. 23, 69 Nov. 22 and 23). A lone boar was observed eating puff-balls (TN 66 Apr. 25) and no doubt they eat other fungi as well—in Europe, domestic pig are used to locate truffles. The fine scent perception of wild pig enable them to locate buried food, and their cartilage reinforced snouts to dig it up.

Smell is the prime sense (TN 66 Apr. 25). Sight and hearing are only fair, but pig are well able to make out moving objects from a distance. When suddenly warned of danger by smell or otherwise, the erectile ridge of hair from the forehead to the hindquarters bristles and stands up suddenly.

Sows build regular nests of tall grass for their accouchement, and in the Mudumalai Sa. in September I saw and heard a sow actually building such a nest, and also some old, abandoned nests in the neighbourhood (TN 66 Sep. 21: photograph TN 46).

In spite of their mass and extraordinarily thickset build, pigs are agile and capable of considerable speed. A very big boar was seen near Jamni village in the Taroba N.P., which leaped easily over a bush, 3-foot high by subsequent measurement (MR 69 Nov. 27). On the same occasion, 5 big pigs were seen lying up in the water of a nullah: it was very cold and late at night, and it was extremely likely that the water was less cold than the air.